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Editor

Clark Wissler

FOREWORD

Louis Robert Sullivan

Since this volume is largely the work of the late Louis Robert Sullivan, a biographical sketch of this able anthropologist, will seem a fitting foreword.

Louis Robert Sullivan was born at Houlton, Maine, May 21, 1892. He was educated in the public schools of Houlton and was graduated from Bates College, Lewiston, Maine, in 1914. During the following academic year he taught in a high school and on November 24, 1915, he married Bessie Pearl Pathers of Lewiston, Maine. He entered Brown University as a graduate student and was assistant in zoology under Professor H. E. Walters, and in 1916 received the degree of master of arts.

From Brown University Mr. Sullivan came to the American Museum of Natural History, as assistant in physical anthropology, and during the first years of his connection with the Museum he laid the foundations for his future work in human biology, by training in general anatomy with Doctor William K. Gregory and Professor George S. Huntington and in general anthropology with Professor Franz Boas. From the very beginning, he showed an aptitude for research and he had not been long at the Museum ere he had published several important papers.

These activities were interrupted by our entrance into the World War. Mr. Sullivan was appointed a First Lieutenant in the Section of Anthropology, Surgeon-General's Office in 1918, and while on duty at headquarters assisted in the compilation of the reports on *Defects found in Drafted Men* and *Army Anthropology*. His particular contribution to these publications was the determination of the 156 standard population sections for the United States. This section map was used as the basis for the published studies issued by the Office of the Surgeon General. When this task was completed, Mr. Sullivan was assigned to Camp Grant to make an anthropometric survey of the recruits stationed there, but before his work was completed his quarters were destroyed by fire and his records were lost. At about this time he was stricken with influenza. Shortly afterward the war ended and in February, 1919, Mr. Sullivan was released from the service and returned to the Museum. During the months following his return to the Museum he suffered a long and serious illness which appears to have had a lasting effect on his health.

In 1920 the American Museum was invited to coöperate with the

Bernice P. Bishop Museum in Honolulu in an anthropological survey of Polynesia and Mr. Sullivan was assigned to organize and work out the racial problem. This was his first important field-work; before this he had confined himself to working either on skeletal material or to the analysis of data accumulated by others. He spent about eighteen months in the Hawaiian Islands, directing the work in physical anthropology conducted by the members of the Bayard Dominick Expeditions of the Bernice P. Bishop Museum and, on his own part, made measurements and observations on about nine thousand children in Honolulu, securing physical data on all the race groups represented in the schools, for all ages from six to nineteen.

After the completion of this field-work Mr. Sullivan returned to his work in the Museum in 1921, but soon was stricken with pleurisy. His failing health necessitated his living in a climate different from that of New York and he took up his residence in Tucson, Arizona. Before this illness he had completed his graduate work and early in 1922 was granted the degree of Doctor of Philosophy at Columbia University.

While in Tucson, Arizona, Doctor Sullivan made a study of the tooth and eye characters of the Mexican and Indian children in the schools. Later, this survey was extended to the children in the Reservation schools of Arizona, New Mexico, California, Nevada, and Oregon. With this second large accumulation of data he returned to the Museum in May, 1924, but unfortunately, very soon after his arrival in New York, it became clear that an immediate return to Tucson was imperative, and after a lingering illness there, he died on April 23, 1925.

Though his scientific career was curtailed and hampered by ill health, especially in the last three years of his life, the bibliographical record of Doctor Sullivan's contributions may offer some measure of the value of his accomplishments:—

Variations in the Glenoid Fossæ (American Anthropologist, n. s., vol. 19, no. 1, 1917).

Growth of the Nasal Bridge in Children (American Anthropologist, n. s., vol. 19, no. 3, 1917).

Racial Types in the Philippine Islands (Anthropological Papers, American Museum of Natural History, vol. 23, part 2, 1918).

Racial Types in the Population of the United States (Natural History, vol. 18, no. 6, 1918).

The Bearing of Physical Anthropology on the Problems of Orthodontia (Dental Cosmos, April, 1918).

The "Samar" United Twins (American Journal of Physical Anthropology, vol. 2, no. 1, 1919).

The Pygmy Races of Man (Natural History, vol. 19, no. 6, 1919).
Anthropometry of the Siouan Tribes (Proceedings of the National Academy of Sciences, vol. 6, no. 3, 1920).
Anthropometry of the Siouan Tribes (Anthropological Papers, American Museum of Natural History, vol. 23, part 3, 1920).
The Fossa Pharyngea in American Indian Crania (American Anthropologist, n.s., vol. 22, 1920).
Differences in the Pattern of the Second Lower Molar Tooth (American Journal of Physical Anthropology, vol. 3, no. 2, pp. 255–257, 1920).
The Status of Physical Anthropology in Polynesia (Proceedings, First Pan-Pacific Scientific Congress, part 1, Bernice P. Bishop Museum, Special Publication, Honolulu, 1921).
The Physical Characteristics of the Two Prehistoric Chilean Miners (Natural History, vol. 21, no. 5, 1921).
A Few Andamanese Skulls with Comparative Notes on Negrito Craniometry (Anthropological Papers, American Museum of Natural History, vol. 23, part 4, 1921).
A Contribution to Samoan Somatology (Memoirs of the Bernice P. Bishop Museum, vol. 8, no. 2, 1921).
A Contribution to Tongan Somatology (Memoirs of the Bernice P. Bishop Museum, vol. 8, no. 4, 1922).
The Frequency and Distribution of Some Anatomical Variations in American Crania (Anthropological Papers, American Museum of Natural History, vol. 23, part 5, 1922).
Marquesan Somatology with Comparative Notes on Samoa and Tonga (Memoirs of the Bernice P. Bishop Museum, vol. 9, no. 2, 1923).
The "Blond" Eskimo—a Question of Method (American Anthropologist, n.s., vol. 24, no. 2, 1922).
Essentials of Anthropometry (Special Publication, American Museum of Natural History, 1923).
New Light on the Races of Polynesia (Asia, January, 1923).
The Racial Diversity of the Polynesian Peoples (The Journal of the Polynesian Society, vol. 32, pp. 79–84, 1923).
Race Types in Polynesia (American Anthropologist, n.s., vol. 26, no. 1, 1924).
Relationships of the Upper Palaeolithic Races of Europe (Natural History, vol. 24, no. 6, 1924).

With Katherine Murdoch

A Contribution to the Study of Mental and Physical Measurements in Normal Children (American Physical Education Review, May and June, 1923).
Some Evidence of an Adolescent Increase in the Rate of Mental Growth (The Journal of Educational Psychology, September, 1922).

With Milo Hellman

The Punin Calvarium (Anthropological Papers, American Museum of Natural History, vol. 23, part 7, 1925).

With Franklin C. Paschal

Racial Influences in the Mental and Physical Development of Mexican Children (Comparative Psychology Monographs, vol. 3, serial no. 14, October, 1925).

The following list includes the most important reviews by Doctor Sullivan.

Arboreal Man, by F. Wood Jones (New York, 1916). In American Anthropologist, n.s., vol. 19, no. 3, 1917.

Organic Evolution. A Text-book, by Richard Swann Lull (New York, 1917). In American Anthropologist, n.s., vol. 20, no. 1, 1918.

The Causes and Course of Organic Evolution; a Study in Bioenergics, by John Muirhead MacFarlane (New York, 1918). In American Anthropologist, n.s., vol. 20, no. 3, 1918.

The Racial History of Mankind, by Roland B. Dixon. In American Anthropologist, n.s., vol. 25, no. 3, 1923.

Vertebrate Zoology, by Horatio Hackett Newman (New York, 1920). In American Anthropologist, n.s., vol. 22, no. 2, 1920.

Richtlinien für Korpermessungen und deren statistische verarbeitung mit besonderer Berucksichtigung von Schul messungen, by Rudolf Martin (Munchen, 1924). In American Anthropologist, n.s., vol. 27, no. 1, 1925.

The Evolution of Man. Essays by G. Elliot Smith, M.A., M.D., (New York, 1924). In American Anthropologist, n.s., vol. 27, no. 1, 1925.

Diet and Race; Anthropological Essays. By F. P. Armitage. In American Anthropologist, n.s., vol. 25, no. 3, 1923.

Catalogue of Human Crania in the United States National Museum Collections: The Eskimo, Alaska and Related Indians, Northeastern Asiatics, by Ales Hrdlicka. In American Anthropologist, n.s., vol. 26, no. 4, 1924.

Immigration in 1917. Based on the Annual Report of the Commissioner General of Immigration, 1917. In American Journal of Physical Anthropology, vol. 1, no. 4, 1918.

Contents of Volume XXIII

vi

ANTHROPOLOGICAL PAPERS

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VOL. XXIII, PART I

RACIAL TYPES IN THE PHILIPPINE ISLANDS

BY

LOUIS R. SULLIVAN

NEW YORK
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1918

RACIAL TYPES IN THE PHILIPPINE ISLANDS.

By Louis R. Sullivan.

PREFACE.

This review is the result of studies made for the purpose of installing a somatological exhibit in the Philippine Hall of the American Museum of Natural History. No new or original data are presented. The purpose of the paper is to bring together the scattered observations of numerous observers in an attempt to indicate the racial affinities of the inhabitants of the Philippine Islands.

While an interpretation which is believed to be consistent with the data is offered, the aim has been to present the data in a form that will enable the reader to draw independent conclusions.

Throughout the study I have enjoyed the constant coöperation of Dr. A. L. Kroeber. I wish to acknowledge his helpful assistance in matters of synonymy, nomenclature, and location of tribes. Map 2 in this review is based on a similar map shortly to appear in Dr. Kroeber's *Peoples of the Philippines* to be published by this Museum.

The text figures and maps were drawn by Mr. S. Ichikawa and are based on Museum labels.

LOUIS R. SULLIVAN.

March, 1918.

CONTENTS.

ILLUSTRATIONS.

Text Figures.

Maps.

THE LITERATURE.

Anthropometric investigations in the Philippine Islands may be said to have been begun by Doctor J. Montano in 1885. Montano[1] made extended studies in the southern half of Luzon and in some of the other islands in the southern part of the Archipelago. His researches were thoroughly scientific and compare very favorably with those of modern workers. In many localities he measured only a few individuals, yet it seems certain that future research will not materially affect his conclusions. Montano recognized three racial types: —

I. Negrito
- Negrito of Bataan
- Mamanua-Mindanao
- Negrito Atas of Luzon

II. Malay
- Plus Chinese: Bikol, Tagalog, Bisaya
- Plus Arabian and Indonesian: Sulu, Moro, Kalagan

III. Indonesian
- Samal (Isamal)
- Bagobo
- Guianga
- Atas
- Tagakaolo
- Tagbanua
- Manobo
- Mandaya
- Bilaan

In addition to his observations on the living, Montana reported on the skeletal material collected and the results of microscopic research on the hair.

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[1] Montano.

Blumentritt's [1] numerous papers on the Philippines did much to clear up ethnographic confusion, as did also those of Meyer [2] and Shadenberg.[3] Numerous verbal and photographic descriptions have appeared by many authors. First among these should be mentioned those of Dean C. Worcester [4] and Meyer [5]. More general discussions may be found in the works of Deniker [6] and Keane [7].

The craniology of the Philippines has been dealt with by Virchow,[8] Schadenberg,[9] and Koeze [10]. The conclusions of Koeze agree in the main with those of Montano and Blumentritt.

Perhaps the most extensive series of measurements on the living are those of Folkmar.[11] In his *Album of Philippine Types* are the averages of the measurements on fairly large series of individuals representing nearly the whole of the Christian population on the Islands.

In 1904 Reed [12] recorded the measurements on the Negrito of Zambales. In the same year Savage Landor [13] made a complete survey of the Islands, but his anthropometric data are of a peculiar character, not comparable with that of other observers. In 1905 Jenks [14] published averages for the Bontok Igorot and in 1906 Kroeber [15] measured individuals from the same locality.

In a series of publications from 1908 to 1913 Bean [16] has contributed much valuable data on the natives of Luzon. Much of his later work is devoted to a scheme for determining racial affinities. Bean recognizes the following types: —

Adriatic (related to Adriatic of Deniker)
Primitive (similar to primitive of Hagen and others)
B. B. B. (big-cerebellumed, box-headed Bavarians of Ranke)
Alpine
Iberian (Mediterranean)
North European (very few on Islands)
Crô-Magnon
Australoid

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[1] Blumentritt, (a), (b), reviewed by Brinton.
[2] Meyer, (a).
[3] Meyer and Schadenberg.
[4] Worcester, (a), (b), (c), (d).
[5] Meyer, (c).
[6] Deniker.
[7] Keane, (a), (b).
[8] Virchow.
[9] Schadenberg, (a).
[10] Koeze.
[11] Folkmar.
[12] Reed.
[13] Savage Landor.
[14] Jenks.
[15] Kroeber.
[16] Bean, (a), (b), (c), (d).

Each of these types presents one or more modified types and there are numerous blends. There is also a type represented by one individual designated as *Homo Philippinensis,* a relative of *Homo Heidelbergensis.*

Of these types Bean says: —

> This scheme is utilized in the segregation of Filipino types, and although an artificial division of the people is affected thereby, the groups segregated not only prove to be true types, but may even be designated as species of man.[1]

One recognizes in this work an attempt to analyze the composition of the various racial types of man, yet the results are far from convincing. As to the source of these heretofore rather unexpected types Bean makes the following explanation: —

> There have been waves and waves of migration which have apparently come from the south, and each succeeding wave finds the drift of the preceding one and in receding leaves its own, sometimes penetrating farther than its predecessor, sometimes falling short and retiring before having reached the remaining portions of the previous waves. Three crescents might be placed across the archipelago to represent the three European migrations.[2]

The crest of the first wave is represented by the Ilongot, the second by the Kalinga and Bontok Igorot, and the third by the Sulu. The Mohammedan wave advanced farther northward, but receded to Sulu when the Spaniards came. The three modified Iberian forms are evidence for three European migrations. The first came from Europe direct, the second by way of India, and the third from northern Africa and Arabia (Mohammedans of history). In this review we shall deal only with Bean's original data.

Barrows[3] published measurements on the Negrito of Palawan, Surigao, and Bataan and also on the wild tribes of Luzon and Palawan. Nine years of residence and travel in the Philippines have convinced him that there is little evidence for an Indonesian theory and that racial diversity can be accounted for by Negrito and Malay intermixture. Barrows strengthens his convictions by data on the nasal index and index of arm reach. The advantages of close contact with the natives for many years cannot be denied; yet, when one considers the great gap between the conclusions of Bean and Barrows it is clear that the personal element must be left out of consideration and the concrete data taken at their face value.

In 1909 Christie[4] published measurements of a group of Subanun from

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[1] Bean, (c), 24.
[2] Bean, (d), 460.
[3] Barrows, (a), (b).
[4] Christie.

Mindanao. In his *The Wild Tribes of Davao District, Mindanao,* Cole [1] gives averages on several heretofore little-known groups. The same author promises more detailed measurements on these people as well as on some of the tribes of northern Luzon. Taylor [2] published the average stature of thirty-six Bontok Igorot, but the remaining measurements have not come to notice.

The most recent publication on the Philippines is the *Population of the Philippine Islands in 1916* by Beyer.[3] In addition to the valuable statistics on the population there is a very convenient alphabetical summary of the ethnic groups. A brief statement is made of the culture and physical type of each group. The following racial types are promised: —

Short Mongol	Papuan
Tall Mongol	Indonesian
Primitive	Ainu
Australoid	Tall Caucasic
Negrito	Malay blend

Numerous Chinese, Japanese, Spaniards, Americans.

The author admits that these are rather unusual types and will, doubtless, produce convincing statistics in a promised forthcoming volume.

THE PROBLEM.

The Philippine problem is a part of the much larger Malay problem. All through Malaysia we find an apparent stratification of the population. In the interior of the various islands, we find tribes variously called "wild", "pagan", or "head hunters". Surrounding these on all sides are the more civilized tribes designated as "civilized" or "christian." These people, for the most part, live near the coast of the Islands. Mingling with these peoples, we have the Mohammedan peoples known as "historic Malays" or "Moros". This stratification is further complicated in some instances, notably the Philippine Islands, by the presence of a fourth element, the pygmy Negrito, who usually occupy the mountain wilds.

This peculiar grouping has given rise to several theories as to the probable origin and affinities of the various groups. Confining our attention to the

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[1] Cole, (c).
[2] Taylor.
[3] Beyer.

Philippines, the most generally accepted explanation is that of Blumentritt.[1] The Negrito were, probably, the first inhabitants of the Islands. We had, in turn, two prehistoric Malay invasions. The first Malay invasion, probably from Borneo, drove the Negrito inland and the newcomers inhabited the coast. The second invasion, also prehistoric, drove the people of the first invasion inland. This resulted in a threefold stratification. Montano [2] and Meyer [3] recognized these three groups, but called the first invaders Indonesian and the second Malay. In the sixteenth century we have the arrival of the Spaniards who were followed and, perhaps, preceded by the Chinese and others.[4]

For the most part, this classification of the population into three types has persisted, nominally at least. There has been some little disagreement in defining the two non-Negrito types and in the classification of the individual tribes or ethnic groups. Deniker [5] and Keane [6] accept it with modifications. Since the year 1900 much new data have been collected and two new tendencies have appeared. Bean,[7] and very recently, Beyer,[8] have greatly increased the number of racial types represented on the Islands. Barrows,[9] on the other hand, has been inclined to discount the idea of multiplicity of types altogether and believes that, apart from the true Negrito, we have representatives of only one racial type and various blends with Negrito.

The existence of the Negrito, as a distinct racial type, is admitted by all. The problem remains to determine whether or not there is any justification in assuming more than one other racial type in the Islands. Ultimately comes the problem deciding the affinities of the inhabitants of the Philippine Islands to the inhabitants of the neighboring islands and the Malay Peninsula, and to mankind in general. This review will be restricted, for the most part, to the first problem.

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[1] Blumentritt, (a), (b) and reviews of same by Brinton.
[2] Montano.
[3] Meyer, (d).
[4] Keane, (a).
[5] Deniker.
[6] Keane, (a), (b).
[7] Bean, (a), (b), (c), (d).
[8] Beyer.
[9] Barrows, (b).

THE METHOD.

The data at hand are sufficiently representative of the entire population of the Philippines to make some sort of a preliminary summary justifiable. The various observers have differed in their choice of measurements, yet in nearly every case we have data on stature, head form, and form of the nose. Our comparison will then be limited principally to these three characters. However, we have enough data on the index of arm reach to make comparison possible. In a few instances, the absolute measurements may be used as a check, but for the most part, only the indices are given. It is to be regretted that the dimensions of the face were not recorded in more instances.

With the exception of a very few smaller series we have only the averages given. For this reason, we shall treat each series as an individual. Some of the observations are for only a very few individuals, yet the records of the different workers overlap sufficiently to permit us to judge fairly accurately the characters of each group considered. In the same way we can determine the comparability of the observations of two, and in some instances three, observers.

For convenience, we shall refer to the ethnic groups under the headings of Christian, Pagan, Mohammedan, and Negrito. Such a classification is obviously inconsistent, for the Negrito are Pagan. Yet, it seemed best to segregate them as a distinct group. Nominally, this subdivision is on the basis of religion, yet it is probably as truly a cultural classification. The Christians are the civilized coast peoples and the Pagans are the wild inland tribes. In culture, the Mohammedans probably stand nearer to the Christians and the Negrito nearer to the Pagans. The statistics on the population, the geographic distribution, and the cultural characterization of each group are taken almost directly from Beyer.[1] Beyer does not claim the accuracy for his census that the figures would imply, yet it is probably safe to say that it is the most accurate that has yet appeared and the most detailed for the ground it covers.

Works on craniometry will be used only as a check. The opinions and general impressions of the different observers will, for the most part, be disregarded and all conclusions will be based on the recorded measurements.

Throughout this review, "race" is used in the sense of one of the larger

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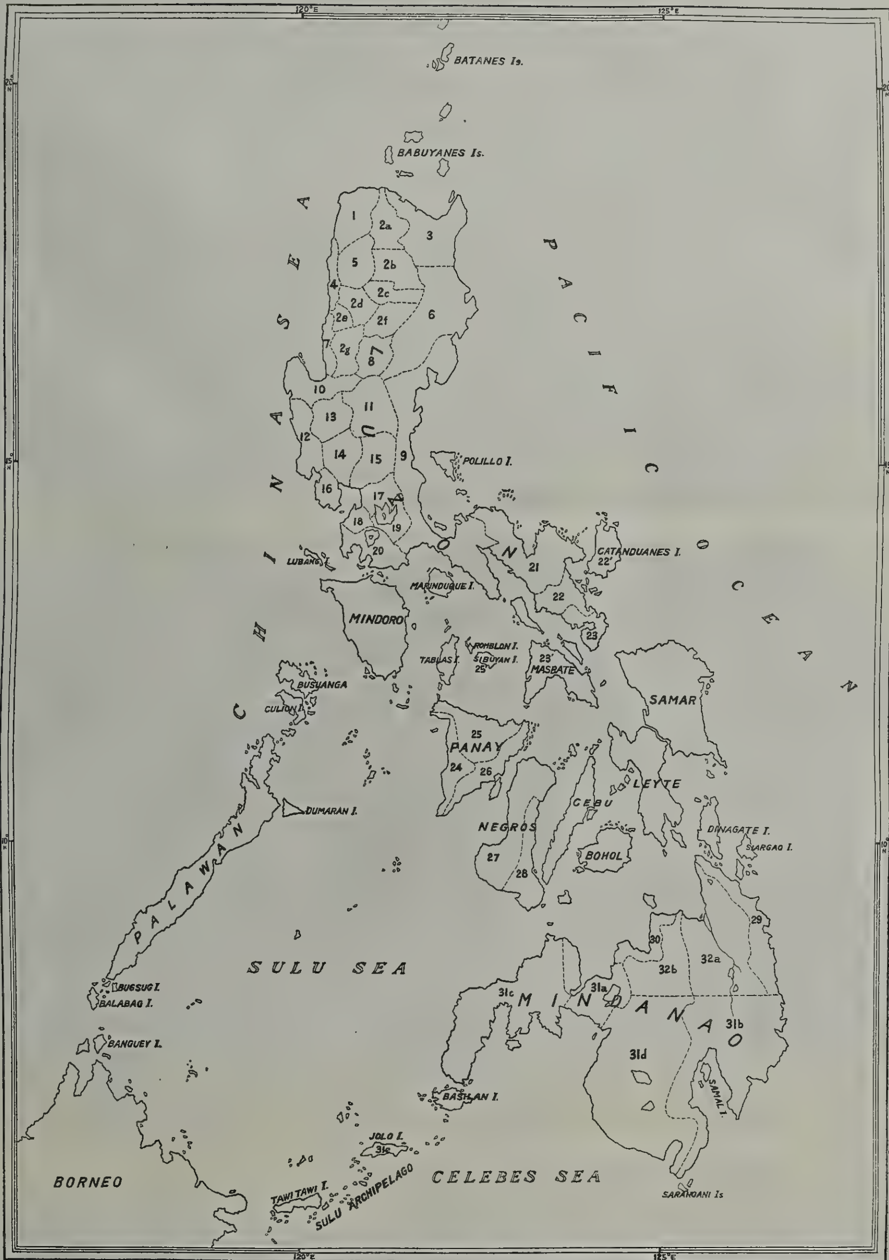
[1] Beyer.



Philippine Islands — Provinces and Districts.

1. Ilokos Norte
2. Mountain
    (a) Apayao
    (b) Kalinga
    (c) Bontok
    (d) Lepanto
    (e) Amburayan
    (f) Ifugao
    (g) Benguet
3. Cagayan
4. Ilokos Sur
5. Abra
6. Isabela
7. La Union
8. Nueva Vizcaya
9. Tayabas
9′. Marinduque Sub-province
10. Pangasinan
11. Nueva Ecija
12. Zambales
13. Tarlak
14. Pampanga
15. Bulakan
16. Bataan
17. Rizal
18. Cavite
19. La Laguna
20. Batangas
21. Ambos Camarines
22. Albay
22′. Catanduanes Sub-province
23. Sorsogon
23′. Masbate Sub-province
    Mindoro
    Samar
    Palawan
24. Antique
25. Capiz
25′. Romblon Sub-province
26. Iloilo
    Leyte
    Cebu
27. Occidental Negros
28. Oriental Negros
    Bohol
29. Surigao
30. Misamis
31. Department of Moro
    (a) Lanao
    (b) Davao
    (c) Zamboanga
    (d) Cotabato
    (e) Sulu
    } Districts
32. Agusan
    (a) Butuan
    (b) Bukidnon
    } Sub-provinces

groups of mankind and refers to the three or four main divisions: Mongoloid, Negroid, Caucasian, and Australoid. Racial type is used to designate one of the smaller and more concrete groups of mankind and is equivalent to sub-race. Any group differing from a racial type in a very few characters only will be designated as a local type.

GEOGRAPHY AND POPULATION.

The Philippine Islands lie southeast of Asia, nearly south of Japan and north of Borneo and Celebes. Geographically, they belong to the same group of islands as Borneo, Sumatra, Java, etc. and are a part of Asia rather than Oceania. They are, for the most part, of volcanic origin and are structurally connected with Borneo and Celebes by three isthmuses which are partly submerged. These three isthmuses enclose the Sulu and Celebes seas. Geologists agree that the Philippine Islands have probably been separated from Borneo and Malaysia since some time in the middle or upper Miocene.[1]

The Archipelago consists of 3,141 islands and has a total area of 115,026 square miles. The interior of most of the islands is mountainous. The principal mountain ranges run north and south as do also the larger islands. The interior of the islands is heavily forested. The population is, in a great measure, distributed along the seaboard, in the great valley of Luzon, in the valley of the Cagayan River, in the valley of the Rio Grande de Mindanao in Mindanao, and in the valleys of smaller streams.

The most densely populated areas are in Ilokos Norte, Ilokos Sur, La Union, Pangasinan, Cagayan, Zambales, Bulakan, Rizal, Laguna, Batangas, Ambos Camarines, Albay and Sorsogon in Luzon, the coast of Samar, Leyte, Panay, Negros, Bohol, northern Mindanao, and nearly all of Cebu. This also represents the range of the Christian peoples. A wide strip in the eastern part of northern Luzon and another in eastern Zambales have a population of less than five persons to the square mile and are inhabited by the Negrito. The same relative density (or sparsity) of population is found in Palawan, the interior of Mindoro, and the greater part of Mindanao. In the latter islands the inhabitants are mainly pagan or wild tribes.

The total population at the end of the year 1915 is given as 9,503,271.[2]

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[1] (Census 1903).
[2] Beyer.

Of these there were: —

8,413,347	Christians
700,000	Pagan
(35,926)	Negrito
315,980	Mohammedan

73,366 inhabitants of the Philippine Islands are foreign born. Of these two-thirds were Chinese and one-sixth were Asiatics or other nationalities. 500,000 native born inhabitants, or 5.26% of the total population, have Chinese blood. 200,000 native born inhabitants, or 2.1% of the total population have Spanish or other European blood.

THE MATERIAL.

I. Christian Groups.

There were 8,413,347 Christians, or civilized people, on the Islands distributed in eight principal ethnic groups. These groups will be considered approximately from north to south.

Iloko [1] (Ilocano): 988, 841; third largest Philippine group.
Distribution: Ilokos Norte, Ilokos Sur, La Union; also in Cagayan, Isabela, Apayao, Pangasinan, Zambales, Tarlak, and Nueva Ecija in Luzon.

1.[2] Iloko of Ilokos Norte — Folkmar.[3]

37 Males

Stature	1593	Head length	180
Arm reach	1657	Head width	151
Cephalic index	84.4	Nasal height	55
Nasal index	73.1	Nasal width	40
Index of arm reach	103.4 [4]	Weight	51.6 kg.

2. Iloko of Ilokos Sur — Folkmar.

59 Males

Stature	1596	Head length	177
Arm reach	1671	Head width	150
Cephalic index	85.1	Nasal height	53
Nasal index	72.9	Nasal width	39
Index of arm reach	104.7	Weight	51.6 kg.

3. Iloko of La Union — Folkmar.

31 Males

Stature	1590	Head length	176
Arm reach	1664	Head width	151
Cephalic index	85.7	Nasal height	50
Nasal index	78.6	Nasal width	39
Index of arm reach	104.6	Weight	51.5

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[1] Statistics on population and distribution are taken from Beyer.
[2] Numbers refer to approximate location on map 2 and are consistently used through the text to refer to these specific groups.
[3] Folkmar.
[4] Calculated from average stature and average arm reach.

4. Iloko of Ilokos Norte and Sur and La Union — Bean.[1]

48 Males

Stature	1615	Head length	182
Cephalic index	83.5	Head width	152
Nasal index	81.8	Nasal height	43
		Nasal width	36.5

5. Iloko of Pangasinan — Folkmar.

34 Males

Stature	1621	Head length	178
Arm reach	1687	Head width	150
Cephalic index	84.3	Nasal height	52
Nasal index	76.5	Nasal width	40
		Weight	52.7

6. Iloko of Tarlak — Folkmar.

8 Males

Stature	1614	Head length	179
Arm reach	1686	Head width	152
Cephalic index	84.7	Nasal height	50
Nasal index	83.6	Nasal width	42
Index of arm reach	104.0	Weight	53.3

7. Iloko of Zambales — Folkmar.

24 Males

Stature	1609	Head length	178
Arm reach	1675	Head width	150
Cephalic index	84.4	Nasal height	51
Nasal index	77.5	Nasal width	39
Index of arm reach	104	Weight	53.6

Cagayan (Ibanag): 156,134; seventh largest group.
Distribution: Cagayan Valley in the provinces of Cagayan and Isabela, Luzon.

8. Cagayan of Cagayan — Folkmar.

10 Males

Stature	1637	Head length	184
Arm reach	1691	Head width	149
Cephalic index	80.8	Nasal height	50
Nasal index	81.1	Nasal width	41
Index of arm reach	103.3	Weight	52.9

9. Cagayan of Isabela — Folkmar.

5 Males

Stature	1594	Head length	184
Arm reach	1645	Head width	149
Cephalic index	80.9	Nasal height	51
Nasal index	78.9	Nasal width	41
Index of arm reach	103.2	Weight	58.9

[1] Bean, (b).

Pañgasinan: 381,493; fifth largest group on the Islands.
Distribution: chiefly in Pangasinan, a few are found in the neighboring provinces of Tarlak, Nueva Ecija, and La Union, Luzon.

10. Pañgasinan of Pangasinan — Folkmar.

40 Males

Stature	1629	Head length	181
Arm reach	1683	Head width	152
Cephalic index	84.2	Nasal height	54
Nasal index	73.5	Nasal width	40
Index of arm reach	103.3	Weight	52.9

Pampañgan: 337,184; sixth largest group on the Islands.
Distribution: Pampanga and part of Tarlak, Luzon.

11. Pampañgan of Pampanga — Folkmar.

62 Males

Stature	1620	Head length	182
Arm reach	1658	Head width	142
Cephalic index	80.7	Nasal height	52
Nasal index	76.2	Nasal width	40
Index of arm reach	102.4	Weight	53.6 kg.

Sambal: 56,146.
Distribution: Province of Zambales and a portion of western Pangasinan.

12. Sambal of Zambales — Folkmar.

17 Males

Stature	1607	Head length	179
Arm reach	1673	Head width	148
Cephalic index	82.7	Nasal height	51
Nasal index	79.6	Nasal width	41
Index of arm reach	104.1	Weight	54.9

Tagalog: 1,789,049; second largest Philippine group.
Distribution: Provinces of Tayabas, Batangas, Cavite, Laguna, Rizal, Manila City, Bataan, Bulakan, and Nueva Ecija; a few in northern Camarines, Tarlak, and southern Zambales, Luzon. In addition to Luzon, the island of Marinduque is wholly Tagalog, Masbate is partly so, and the coastal region of the northern two-thirds of Mindoro.

13. Tagalog of Nueva Ecija and Nueva Vizcaya — Bean.

17 Males

Stature	1661	Head length	183
Cephalic index	83.6	Head width	153
Nasal index	80.0	Nasal height	48
		Nasal width	39

14. Tagalog of Nueva Ecija — Folkmar.

26 Males

Stature	1610	Head length	180
Arm reach	1668	Head width	150
Cephalic index	83.3	Nasal height	50
Nasal index	80.4	Nasal width	40
Index of arm reach	103.6	Weight	52.0

15. Tagalog of Zambales — Bean.

9 Males

Stature	1651	Head length	183
Cephalic index	84.1	Head width	156
Nasal index	79.6	Nasal height	48
		Nasal width	38

16. Tagalog of Pangasinan — Bean.

18 Males

Stature	1610	Head length	181
Cephalic index	84.7	Head width	153
Nasal index	85.0	Nasal height	45
		Nasal width	38

17. Tagalog of Pampanga — Bean.

22 Males

Stature	1635	Head length	185
Cephalic index	81.3	Head width	150
Nasal index	87.6	Nasal height	44
		Nasal width	38

18. Tagalog of Bulakan — Folkmar.

22 Males

Stature	1597	Head length	180
Arm reach	1654	Head width	153
Cephalic index	84.7	Nasal height	50
Nasal index	82.0	Nasal width	41
Index of arm reach	104.0	Weight	54.5

19. Tagalog of Bulakan — Bean.

26 Males

Stature	1636	Head length	181
Cephalic index	84.2	Head width	152
Nasal index	83.2	Nasal height	45
		Nasal width	37

20. Tagalog of Tayabas — Folkmar.

28 Males

Stature	1579	Head length	180
Arm reach	1645	Head width	148
Cephalic index	82.3	Nasal height	52
Nasal index	76.0	Nasal width	40
Index of arm reach	104.2	Weight	50.7

21. Tagalog of Tayabas — Bean.

15 Males

Stature	1606	Head length	180
Cephalic index	83.3	Head width	150
Nasal index	83.3	Nasal height	46
		Nasal width	38

22. Tagalog of Rizal — Folkmar.

25 Males

Stature	1579	Head length	184
Arm reach	1645	Head width	149
Cephalic index	81.2	Nasal height	51
Nasal index	80.5	Nasal width	41
Index of arm reach	104.2	Weight	53.4

23. Tagalog of Rizal — Bean.

31 Males

Stature	1628	Head length	181
Cephalic index	83.4	Head width	151
Nasal index	83.2	Nasal height	44.7
		Nasal width	37.2

24. Tagalog of Manila — Bean.

40 Males

Stature	1638	Head length	181
Cephalic index	82.3	Head width	149
Nasal index	83.8	Nasal height	43.9
		Nasal width	36.9

25. Tagalog of Cavite — Folkmar.

20 Males

Stature	1592	Head length	180
Arm reach	1645	Head width	149
Cephalic index	83.3	Nasal height	51
Nasal index	78.3	Nasal width	40
Index of arm reach	103.3	Weight	52.3

26. Tagalog of Cavite — Bean.

10 Males

Stature	1667	Head length	185
Cephalic index	82.9	Head width	154
Nasal index	81.0	Nasal height	46.4
		Nasal width	37.6

27. Tagalog of La Laguna — Folkmar.

20 Males

Stature	1600	Head length	179
Arm reach	1632	Head width	149
Cephalic index	83.0	Nasal height	50
Nasal index	81.9	Nasal width	41
Index of arm reach	102.0	Weight	54.9

28. Tagalog of La Laguna — Bean

14 Males

Stature	1626	Head length	182
Cephalic index	81.3	Head width	148
Nasal index	84.3	Nasal height	43.9
		Nasal width	37.0

29. Tagalog of Batanga — Bean.

12 Males

Stature	1642	Head length	182
Cephalic index	83.7	Head width	152
Nasal index	79.8	Nasal height	47
		Nasal width	38

30. Tagalog of Batanga — Folkmar.

28 Males

Stature	1611	Head length	180
Arm reach	1668	Head width	150
Cephalic index	82.0	Nasal height	51
Nasal index	79.7	Nasal width	41
Index of arm reach	103.5	Weight	53.2

31. Tagalog? — Cainta, Rizal — Bean and Planta.[1]

38 Males

Stature	1609	Head length	184
Cephalic index	80.4	Head width	147
Facial index	85.7	Nasal height	48
Nasal index	82.8	Nasal width	39
Facial height	115	Ear height	61
Facial width	134		

32. Tagalog? — Taytay, Rizal — Bean and Planta.[2]

181 Males

Stature	1595	Head length	183.0
Cephalic index	81.8	Head width	149.6
Facial index	81.3	Nasal height	47.1
Nasal index	85.2	Nasal width	40.0
Facial height	112.0	Ear height	61.5
Facial width	137.7		

Bikol: 685,309; fourth largest Philippine group.

Distribution: Ambos Camarines, Albay and Sorsogon on Luzon and the islands of Catanduanes and Masbate.

33. Bikol of Ambos Camarines — Folkmar.

18 Males

Stature	1585	Head length	184
Arm reach	1663	Head width	151
Cephalic index	81.6	Nasal height	51
Nasal index	81.5	Nasal width	41
Index of arm reach	104.9	Weight	53.3

[1] Bean and Planta, (b).

[2] Bean and Planta, (a).

34. Bikol of Sorsogon — Folkmar.

32 Males

Stature	1595	Head length	178
Arm reach	1658	Head width	151
Cephalic index	84.7	Nasal height	50
Nasal index	80.4	Nasal width	41
Index of arm reach	104.0	Weight	53.4

35. Bikol of Albay — Folkmar.

11 Males

Stature	1583	Head length	181
Arm reach	1672	Head width	148
Cephalic index	82.2	Nasal height	48
Nasal index	86.1	Nasal width	42
Index of arm reach	105.7	Weight	56.6

36. Bikol of Camarines, Albay, Sorsogon, etc.— Bean.

14 Males

Stature	1632	Head length	182
Cephalic index	83.5	Head width	152
Nasal index	86.3	Nasal height	45
		Nasal width	39

Bisaya: 3,977,210; largest group in the islands.

Distribution: Samar, Leyte, Cebu, Negros, Bohol, Panay, and the remaining smaller Bisayan Islands; coast region of southern Mindoro, coast of Palawan; and the north and east coasts of Mindanao.

37. Bisaya of Romblon Island — Folkmar.

3 Males

Stature	1622	Head length	180
Arm reach	1706	Head width	146
Cephalic index	80.9	Nasal height	53
Nasal index	75.0	Nasal width	40
Index of arm reach	105.2	Weight	56.6

38. Bisaya of Masbate Island — Folkmar.

7 Males

Stature	1588	Head length	179
Arm reach	1633	Head width	154
Cephalic index	86.3	Nasal height	48
Nasal index	84.4	Nasal width	40
Index of arm reach	102.2	Weight	53.3

39. Bisaya of Capiz Province, Panay Island — Folkmar.

27 Males

Stature	1590	Head length	181
Arm reach	1683	Head width	150
Cephalic index	83.0	Nasal height	49
Nasal index	85.0	Nasal width	42
Index of arm reach	105.9	Weight	53.2

40. Bisaya of Iloilo Province, Panay Island — Folkmar.

40 Males			
Stature	1586	Head length	180
Arm reach	1661	Head width	149
Cephalic index	83.1	Nasal height	49
Nasal index	84.1	Nasal width	41
Index of arm reach	104.7	Weight	51.0

41. Bisaya of Samar Island — Folkmar.

31 Males			
Stature	1558	Head length	176
Arm reach	1639	Head breadth	150
Cephalic index	85.5	Nasal height	48
Nasal index	81.9	Nasal width	40
Index of arm reach	105.2	Weight	49.8

42. Bisaya of Leyte Island — Folkmar.

46 Males			
Stature	1583	Head length	180
Arm reach	1648	Head width	152
Cephalic index	85.3	Nasal height	51
Nasal index	78.6	Nasal width	40
Index of arm reach	104.1	Weight	51.6

43. Bisaya of Cebu Island — Folkmar.

32 Males			
Stature	1599	Head length	181
Arm reach	1666	Head width	152
Cephalic index	83.7	Nasal height	48
Nasal index	79.6	Nasal width	38
Index of arm reach	104.2	Weight	52.3

44. Bisaya of Oriental Negros — Folkmar.

15 Males			
Stature	1607	Head length	180
Arm reach	1681	Head width	153
Cephalic index	84.9	Nasal height	51
Nasal index	80.9	Nasal width	41
Index of arm reach	104.6	Weight	56.5

45. Bisaya of Occidental Negros — Folkmar.

10 Males			
Stature	1554	Head length	182
Arm reach	1618	Head width	150
Cephalic index	82.7	Nasal height	50
Nasal index	81.9	Nasal width	41
Index of arm reach	104.1	Weight	49.0

46. Bisaya of Bohol Island — Folkmar.

16 Males

Stature	1594	Head length	178
Arm reach	1676	Head width	151
Cephalic index	84.7	Nasal height	49
Nasal index	80.5	Nasal width	40
Index of arm reach	105.1	Weight	48.2

47. Bisaya of Surigao Province, Mindanao — Folkmar.

21 Males

Stature	1594	Head length	178
Arm reach	1660	Head width	152
Cephalic index	85.8	Nasal height	49
Nasal index	83.3	Nasal width	41
Index of arm reach	104.1	Weight	48.2

48. Bisaya of Misamis, Mindanao — Folkmar.

11 Males

Stature	1612	Head length	179
Arm reach	1692	Head width	153
Cephalic index	85.5	Nasal height	51
Nasal index	82.6	Nasal width	42
Index of arm reach	104.9	Weight	56.3

There are no data for the following minor Christian groups recognized by Beyer: —

Ivatan:	6,392;	Batanes Islands
Gaddang A:	21,240;	Nueva Vizcaya and Isabela, Luzon.
Kalamian:	11,350;	Kalamianes and Kuyo Islands near Palawan.
Isinai:	2,647;	3 towns in Nueva Vizcaya, Luzon.
Dumagat:	352;	Kalawat Islands.

II. Pagan Groups.

There are 700,000 pagan or uncivilized people in the Philippines. We shall consider first the Luzon groups. The wild tribes inhabit the interior of Luzon and in earlier literature are referred to as Igorot. Of these groups we have no data on the following: —

Apayao:	23,000;	Apayao, Ilokos Norte, and Cagayan.
Kalinga:	67,450;	Kalinga, Apayao, and Cagayan.
Tinggian:	27,648;	Abra and neighboring provinces.
Gaddang B:	12,480;	Kalinga and Isabela.

Bontok (Igorot); 63,258.

Distribution: sub-province of Bontok and neighboring provinces.

49. Bontok of Bontok — Kroeber.[1]

18 Males

Stature	1550	Head length	186
Arm reach	1572	Head width	146
Cephalic index	78.4	Face height	110
Nasal index	99.8	Face width	135
Facial index	81.0	Nasal height	41
Index of arm reach	101.6	Nasal width	40

50. Bontok of Lepanto — Bean.[2]

14 Males

Stature	1586	Head length	188
Cephalic index	77.1	Head width	145
Nasal index	97.6	Face height	108
Facial index	78.8	Face width	137
		Nasal height	41
		Nasal width	40
		Ear height	57.2

51. Bontok of Bontok — Jenks.[3]

14 Males

Stature	1602	Head length	192
Cephalic index	79.1	Head width	152
Nasal index	79.2	Nasal length	52.6
		Nasal width	42.6

Kankanai (Igorot): 47,887

Distribution: Northern third of Benguet and part of Lepanto and Amburayan.

52. Kankanai of northern Benguet — Barrows.[4]

10 Males

Stature	1505.7
Cephalic index	81.6
Nasal index	88.7

Nabaloi (Igorot, Inibaloi, Ibalois): 13,421.

Distribution: Southern Benguet and neighboring provinces.

53. Nabaloi of Agno Valley, Benguet — Bean.[5]

22 Males

Stature	1536	Head length	186.0
Cephalic index	78.5	Head width	146.0
Facial index	80.4	Nasal height	40.0
Nasal index	95.0	Nasal width	38.0
Face height	107	Ear height	56.7
Face width	133		

[1] Kroeber.
[2] Bean, (a).
[3] Jenks.
[4] Barrows, (b).
[5] Bean, (a).

54. Nabaloi of West Benguet — Bean.

46 Males

Stature	1549	Head length	189
Cephalic index	77.8	Head width	147
Facial index	79.0	Nasal height	43
Nasal index	88.4	Nasal width	38
Face height	109	Ear height	59.3
Face width	138		

55. Nabaloi of Baguio, Benguet — Bean.

22 Males

Stature	1491	Head length	186
Cephalic index	78.5	Head width	146
Facial index	80.4	Nasal height	40
Nasal index	95.0	Nasal width	38
Facial height	107	Ear height	56.7
Facial width	133		

56. Nabaloi of Kayapa, Benguet — Barrows.

7 Males

Stature	1543
Arm reach	1590
Cephalic index	79.2
Nasal index	101.0
Index of arm reach	103.

57. Nabaloi of Southern Benguet — Barrows.

12 Males

Stature	1563.4	Cephalic index	76.2	Nasal index	92.1

Ifugao: 132,500; largest non-Christian group.
Distribution: mostly in Ifugao; few in neighboring provinces.

58. Ifugao of Benawi — Barrows.

10 Males

Stature	1552	Cephalic index	76.9	Nasal index	101.9

Ilongot: 6,150.
Distribution: mostly in Nueva Vizcaya about headwaters of the Cagayan River.

59. Ilongot of Nueva Vizcaya — Barrows.

4 Males

Stature	1540	Cephalic index	83.3	Nasal index	86

60. Ilongot of Pantabangan, Nueva Ecija — Barrows.

12 Males

Stature	1563	Cephalic index	82.5	Nasal index	89.2

Mangyan: 12,250; interior of Mindoro Island. No data.

Unclassified: 46,015. There are five main groups of Mountain people variously called "Non-Negroid," "Semi-Negroid," "Hill people," "remontados" scattered throughout the Archipelago. In the earlier census, they have been called "Bukidnon." Bukidnon is now restricted to a group living in Mindanao. The others are distributed as follows:—

(a) Mountains of Central Luzon (4,316).
(b) Southern Luzon (4,600) Katabangan.
(c) Central part of Samar (1,420).
(d) Central part of Negros (19,258).
(e) Central part of Panay (16,421).

On Map 2 these groups are designated as "Hill People".

Of these groups we have data on the following only:—

61. Katabangan? of Camarines Sur — Montano.

2 Males

Stature 1550 Cephalic index 81.3 Nasal index 93.9

Manobo: 39,600.
Distribution: Agusan River Valley, Mindanao.

62. Manobo of Davao, Mindanao — Montano.

3 Males

Stature 1616 Cephalic index 77.9 Nasal index 93.5

63. Manobo of Agusan, Mindanao — Montano.

5 Males

Stature 1518 Cephalic index 82.5 Nasal index 93.4

Subanun: 31,450 exclusive of numerous Christians and Mohammedans.
Distribution: The interior of the whole Zamboanga Peninsula, Mindanao.

64. Subanun of Zamboanga (coast), Mindanao — Christie.

20 Males

Stature	1608	Head length	177.0
Cephalic index	82.6	Head width	147.4
Nasal index	74.8	Nasal height	52.6
		Nasal width	39.9

Tagakaolo: 7,100.
Distribution: Interior of Saragani Peninsula and west coast of the Gulf of Davao, Mindanao.

65. Tagakaolo of Davao, Mindanao — Cole.[1]

27 Males

Stature 1574 Cephalic index 81.5

65′. Tagakaolo of Davao.

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[1] Cole, (c).

Montano measured two men:—

Stature 1594 Cephalic index 80.8 Nasal index 85.5

Kulaman: 3,600

Distribution: Saragani Peninsula, Mindanao.

66. Kulaman of Davao, Mindanao — Cole.

27 Males

Stature 1583 Cephalic index 78.1

Mandaya: 25,000.

Distribution: east and north of Davao Gulf, Mindanao.

67. Mandaya of Davao, Mindanao — Cole.

15 Males

Stature 1539 Cephalic index 84.6

67′. Montano measured two men:—

Stature 1578 Cephalic index 81.3 Nasal index 90.8

Bilaan: 10,400.

Distribution: Davao and Cotabato, Mindanao.

68. Bilaan of Davao, Mindanao — Cole.

38 Males

Stature 1547 Cephalic index 80.4

68′. Montano measured 3 females and 4 young males.
They have an average nasal index of about 90.

Bagobo: 9,350.

Distribution: Northwest coast of Davao Gulf, Mindanao.

69. Bagobo of Davao, Mindanao — Cole.

33 Males

Stature 1586 Cephalic index 78.8

69′. 1 Male (Montano)

Stature 1538 Cephalic index 81.4 Nasal index 77.8

4 Male Guingas (Bagobo?) — Montano.

Stature 1630 Cephalic index 80.7 Nasal index 79.7

Tagbanua: 19,460

Distribution: Mountainous interior of Palawan.

70. Tagbanua of Palawan — Barrows.

5 Males.

Stature 1550 Cephalic index 81.0 Nasal index 93.4

1 Male (Montano)

Stature 1565 Cephalic index 80 Nasal index 93.0

Atá: 7,500
Distribution: Davao province, Mindanao.

71. Atá of Davao, Mindanao — Montano.

1 Male — adult.

Stature	1688	Cephalic index	82.2	Nasal index	78.4

We have no data on the following groups:—

Tirurai:	7,150;	Cotabato, Mindanao.
Bukidnon:	48,500;	Bukidnon, Mindanao.
Manguangan:	2,500;	central Mindanao.

III. Mohammedan Groups.

There are about 315,980 Mohammedans. For the most part, they are called "Moros." A few of the groups have more specific names. They are all in the southern part of the Archipelago in and around Mindanao.

72. Kalagan of Davao Gulf, Mindanao — Montano.

1 Male

Stature	166	Cephalic index	79.5	Nasal index	102.5

73. Isamal (Samal) of Samal Island, Mindanao — Montano.

2 Males

Stature	1579	Cephalic index	81.9	Nasal index	80.4

74. Moro of Davao, Mindanao — Montano.

5 Males

Stature	1573	Cephalic index	81.9	Nasal index	84.6

75. Moro of Cotabato, Mindanao — Folkmar.

2 Males

Stature	1599	Cephalic index	80.9	Nasal index	81.7

76. Moro of Zamboanga, Mindanao — Folkmar.

6 Males

Stature	1613	Cephalic index	80.8	Nasal index	81.0
Arm reach	1696	Index of arm reach	105.1	Weight	48.9

77. Moro of Basilan Island — Folkmar.

2 Males

Stature	1556	Cephalic index	83.6	Nasal index	85.1

78. Moro of Sulu Island — Folkmar.

10 Males

Stature	1596	Head length	180
Arm reach	1645	Head width	150
Cephalic index	83.1	Nasal height	50
Nasal index	83.2	Nasal width	42
Index of arm reach	103.1	Weight	51.4

79. Sulu of Sulu Island — Montano.

6 Males

Stature	1526	Index of arm reach	103.8	Cephalic index	84.7
				Nasal index	86.6

We have used the names given by the observer in every case but the following specific names are substituted for "Moro" by Beyer.[1]

Samal;	78,700;	Sulu Archipelago.
Lanao;	58,350;	Lanao — Mindanao.
Yakan;	7,290;	Basilan Islands.
Palawan;	1,940;	Southern Palawan.
Magindanao;	79,850;	Cotabato, Mindanao.
Sanggil;	2,450;	South coast of Mindanao.
Sulu;	87,400;	Jolo Island, etc.

IV. Negrito Groups.

According to Beyer[2] there are seven principal groups of Negrito. The total number is approximately 35,926. They are distributed as follows: —

(a) Apayao swamp region, Apayao and Cagayan; 4,500.
(b) Ilokos Mountains mostly in Ilokos; 415.
(c) Zambales Mountains, Zambales, Bataan, etc.; 9,186.
(d) East Luzon Mountains from Cape Engano to Lucena, Tayabas; 12,500.
(e) South Luzon Mountains, Tayabas, Camarines and Albay; 4,800.
(f) "Bataks" of Palawan; 675.
(g) "Mamanua" of Surigao — Mindanao; 3,850.

Smaller groups are mixed with some of the "hill tribes" on other islands.

We have the following data: —

80. Negrito of Bataan, Luzon — Montano.

18 Males

Stature	1485	Index of arm reach	105.3	Cephalic index	84.7
				Nasal index	94.7

81. Negrito (Aeta) of Zambales, Luzon — Reed.[3]

31 Males (27 females also measured)

Stature	1463	Head length	177.5
Cephalic index	82.2	Head width	147.0
Nasal index	106.0	Nasal height	40.5
		Nasal width	42.8

One female had a nasal index of 140.

[1] Beyer. [2] Beyer. [3] Reed.

82. Negrito of Bataan, Luzon — Barrows.

9 Males

Stature 1454 Cephalic index 82.3 Nasal index 93.7

83. Negrito (Mamanua) of Surigao, Mindanao — Barrows.

3 Males

Stature 1590 Cephalic index 84 Nasal index 103

84. Negrito (Batak) of Palawan — Barrows

4 Males

Stature 1500 Cephalic index 81 Nasal index 97
(According to Beyer the Bataks are Papuan?)

85. Negrito-Metis of Albay — Montano.

5 Males

Stature 1504 Cephalic index 85.8 Nasal index 92.7

HAIR, SKIN, AND EYES.

In only a comparatively few instances do we have statistical records of skin color, hair form, and eye color. Montano and Kroeber have recorded skin color according to Broca's color scale. Cole has evidently made careful studies of this character, but has not yet published detailed information. However, there are not sufficient data on these characters at the present time to make them of any value in a minute comparative study.

The hair is almost uniformly black. The Negrito range from curly to woolly hair. The other inhabitants of the islands have straight or wavy hair. One gathers the impression that straight hair is most common, but that wavy hair frequently occurs in all groups, though more frequently in some of the pagan tribes of northern Luzon, Mindanao, and Palawan.

As to skin color, about all there can be said is that the Negrito vary from dark brown to black and that the other natives show varying shades of brown. The shades most frequently reported are numbers 21 and 37 of Broca's standard scale. Kroeber's Bontok were between 25 and 31 of Broca's scale. Montano recorded numbers 40 and 47 in several instances. The Bikol are the only Christians for whom we have records and they are reported as being most frequently of the shade of number 21 of Broca. Some of the pagan people are described as being of a very light shade. Caucasian affinities are claimed for some.

The eye color is reported as varying from a medium to a very dark brown. The eyes of the Negrito are wide open. The eyes of many of the other natives suggest the Mongol eye. The Mongoloid fold is reported to be as frequent as fifty or sixty percent in some cases among the Christian people. It is also found among the pagan and Mohammedan people. Jenks noted it among the Bontok and Christie among the Subanun. Other observers claim it to be of rare occurrence among the pagan tribes of Luzon. Although the statement cannot be made with certainty, it seems that the Mongoloid eye fold and obliquely placed eye slits are more frequent among the Christians than among the pagan people, at least in Luzon.

STATURE.

Stature is very frequently looked upon as the direct expression of economic well-being or the reverse. Within certain limits this is undoubtedly true, yet it has not been sufficiently demonstrated that stature is propor-

tionately more variable than certain other accepted characters descriptive of racial types. If we analyze the curve expressing the stature of mankind we do not find a random distribution, but notice that the main curve is composed roughly of a series of minor curves. The average and roughly the mode of the composite curve is at the 165 centimeter space, or five feet five inches. The stature for the Negroid groups presents two curves with one mode at 152 and 153 centimeters and another at 167 centimeters approximately. The Asiatic Mongols range above and below 160 and 161 centimeters. The mode for Europeans is approximately 165 centimeters and the curve for American Indians is almost a duplication of the curve for Europeans.

However, stature like all other anthropometric characters, is valuable only when we have the seriation, variability, and average of a fairly large series of observations. In only a few instances have observations been made on a very large number of Philippine natives, yet the uniformity of the averages of different observers convinces us that the data at hand may be regarded as expressing approximately the range of stature on the Islands.

For convenience in reviewing the range of this character, we have placed each ethnic group together with its geographic location and a symbol to designate whether it is Christian, Pagan, Mohammedan, or Negrito, opposite the number expressing the average stature in Fig. 1. This allows us to consider at one time the anthropometric, geographical, and ethnic relationships of the different groups. The grouping represents roughly the range and curve of stature in the Philippine Islands.

The first observation of significance is that the averages for nearly every group on the Islands fall below 165 centimeters, or the average stature of mankind. The bulk of the population of the Philippine Islands belongs to the shorter group of men. The range is from 145 to 167 centimeters, or 23 centimeters. The curve is asymmetrical. The Negrito, for the most part, do not fall within the main curve. Omitting the Negrito from our consideration, we still have a major and a minor mode, the first between 159 and 161 centimeters and a second at 155 centimeters. The Christian groups are the taller and are at the top, the Negrito are the shortest and are at the bottom of the scale, and the Pagan groups are intermediate between the two. The Mohammedan groups are scattered throughout the range of the Christian and Pagan groups. If we analyze the curve in greater detail we get the seriations and averages shown in the following table. We see that the averages of three of the classes, Christian, Pagan, and Negrito, correspond fairly well with the major and minor modes and there is another at 150 centimeters for the Negrito. It seems then, that to a certain extent, stature is associated with the classification adopted for analysis.

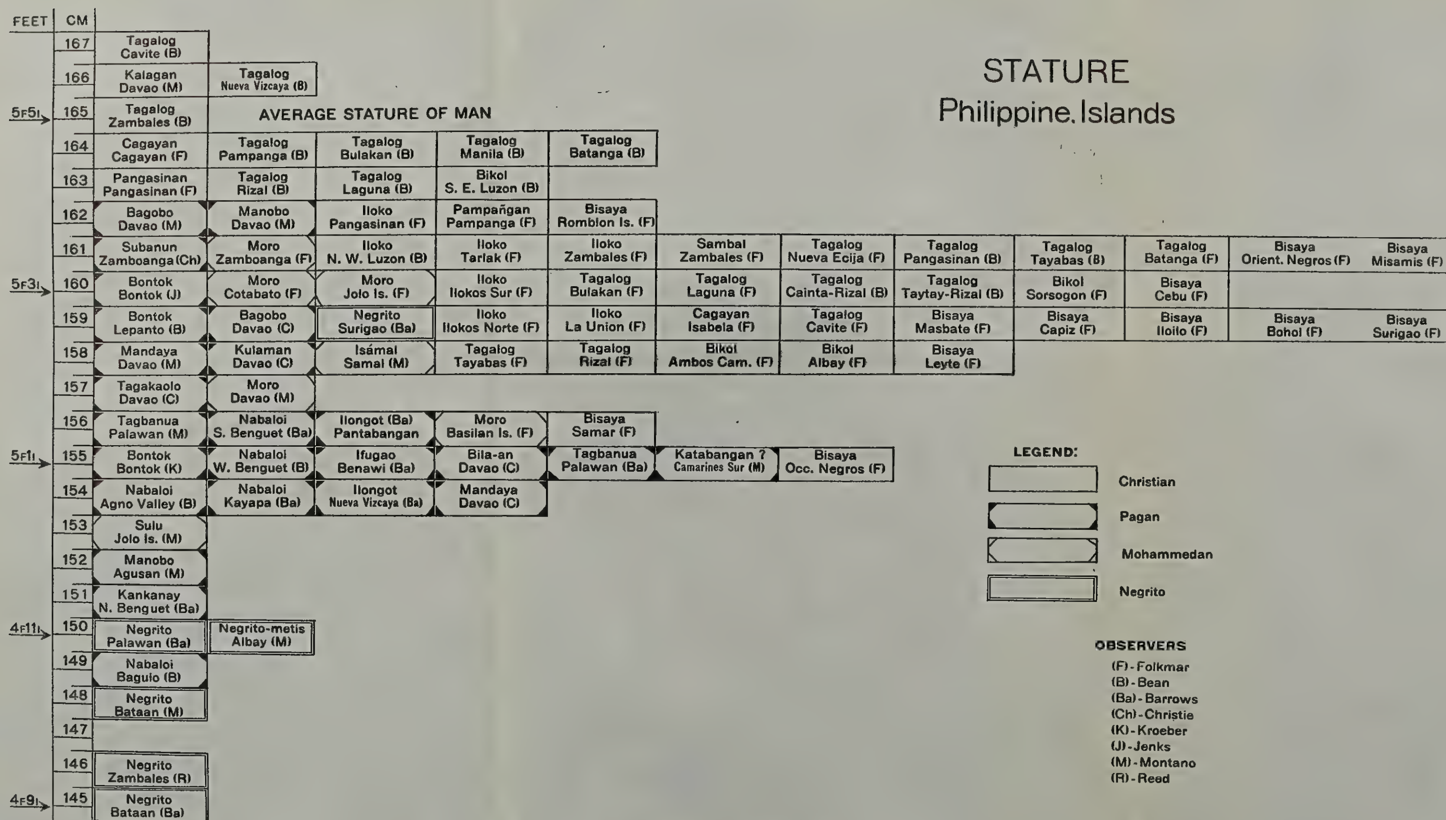

Fig. 1. Stature in the Philippine Islands.

Average Stature	Christian	Pagan	Mohammedan	Negrito	Total
167	1				1
166	1		1		2
165	1				1
164	5				5
163	4				4
162	3	2			5
161	10	1	1		12
160	7	1	2		10
159	9	2	0	1	12
158	5	2	1		8
157	0	1	1		2
156	1	3	1		5
155	1	6			7
154		4			4
153		0	1		1
152		1			1
151		1			1
150		0		2	2
149		1			1
148				1	1
147					0
146				1	1
145				1	1
Averages:	160.5	156.0	159.0	150.0	158.5

For some of the Christian groups, we have data by several observers from several provinces. Let us consider the distribution of stature among these groups in greater detail.

Seriation of Stature: Christians.

	Tagalog	Cagayan	Pangasinan	Pampanga	Bisaya	Iloko	Bikol	Sambal	Total
167	1								1
166	1								1
165	1								1
164	4	1							5
163	2		1				1		4
162	0			1	1	1	0		3
161	4				2	3	0	1	10
160	4				1	1	1		7
159	1	1			5	2	0		9
158	2				1		2		5
157					0				0
156					1				1
155					1				1
Averages:	162	161.5	163	162	159	160.5	160	161	160.5

The Tagalog vary from 158 to 167 centimeters and are apparently taller than the more southern Christian groups, the Bisaya and the Bikol. The Pangasinan and the Pampanga are also tall, while the Sambal, the Iloko, and the Cagayan are about the average. It remains to determine whether they are divergent in more than one character.

CEPHALIC INDEX.

Head form, as expressed by the cephalic index, is recorded for nearly all of the groups measured. There is one great source of error in this observation which should be taken into account. Artificial deformation of the head has been prevalent in the Philippine Islands at one time or another as the crania, described by Koeze,[1] testify. Among the crania collected in caves, several show the fronto-occipital deformation and others an occipital flattening. No specific reference to the practice has been noted, yet some of the photographs of Folkmar suggest an occipital flattening. Only recently Ten Kate [2] has called attention to the practice of moulding the head of the new-born child in Java. The effect of the process is to shorten the head in the antero-posterior direction. Hose and McDougall [3] have recorded the practice of occipital flattening in Borneo. In view of these facts, more attention should be paid to the detection of such deformations. Failure to do so will seriously affect any statistical treatment of the cephalic index.

In Fig. 2, we have placed the respective ethnic groups above the number expressing the average cephalic index for the group. We shall regard the cephalic index as a purely descriptive character. Long and short head will be used with reference to conditions in the Philippine Islands and not as synonyms of brachycephaly and dolichocephaly. The difference between an average of 78 and one of 80 will be regarded as significant as a difference between an average of 80 and an average of 82.

Our curve is by no means symmetrical. The mode (81–82) is approximately the median (81), but nearly three times as many cases fall to right as to the left of 81. The tendency of the group as a whole is toward short-headedness and nearly two-thirds of the cases fall within the limits of brachycephaly. The Negrito and all of the Christian groups, except one, have an index of 81 or above. The Mohammedan range from 79 to 85. The Pagan groups show two modes, one at 78 and another at 81, but on the whole,

[1] Koeze.
[2] Ten Kate, (a).
[3] Hose and McDougall.

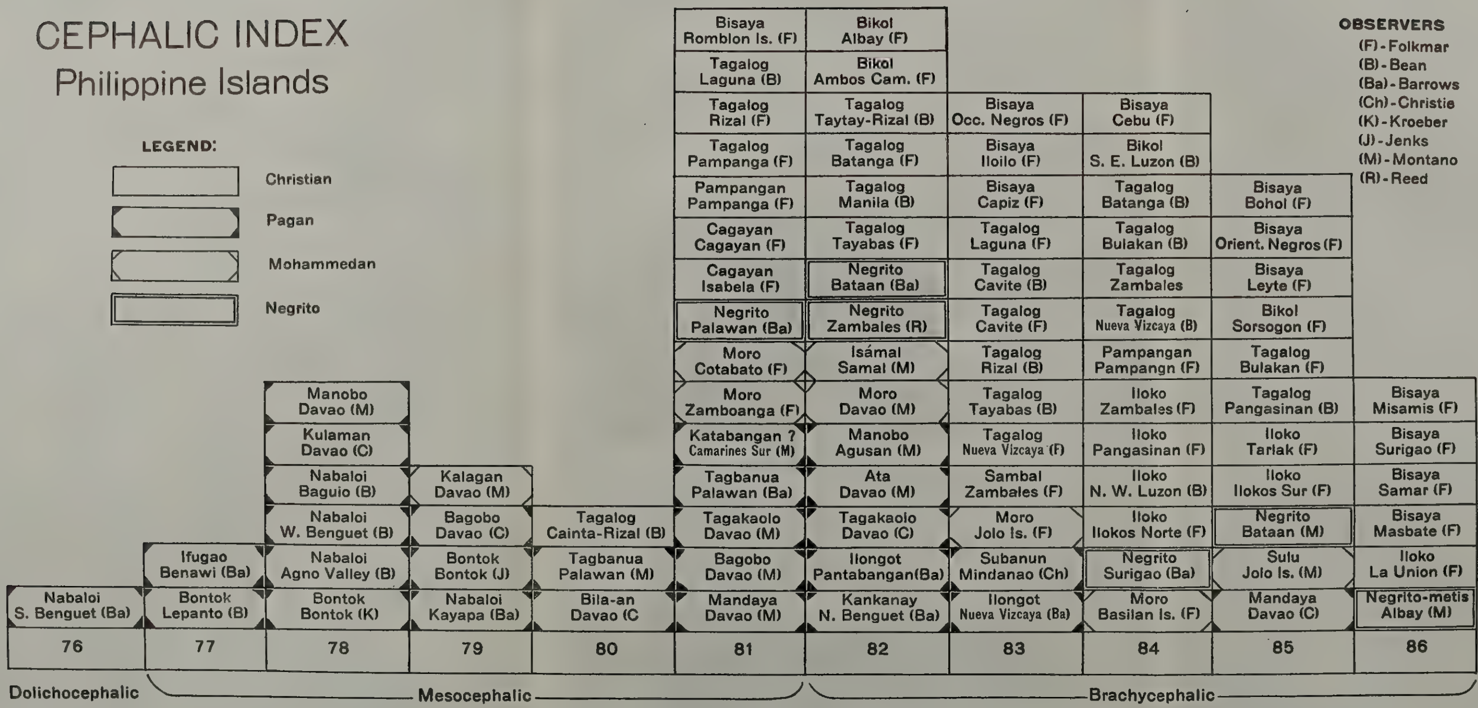

Fig. 2. The Cephalic Index in the Philippine Islands.

are longer-headed than the other groups. The relationships of the various groups are more clearly seen in the following seriation: —

Cephalic Index	Christian	Pagan	Mohammedan	Negrito	Total
76		1			1
77		2			2
78		6			6
79		3	1		4
80	1	2	0		3
81	7	5	2	1	15
82	6	5	2	2	15
83	10	2	1	0	13
84	11	0	1	1	13
85	8	1	1	1	11
86	5			1	6
Averages:	83.5	80.0	82.0	83.3	82.2

The differences are small, yet the conditions are similar to those we found for stature. There is a certain amount of overlapping, yet the overlapping is by the Pagan groups. This may seem an arbitrary statement of the case, yet a comparison of the data on stature and the cephalic index seems to warrant this interpretation. The Christian peoples are less variable in both of these characters. Below is the seriation of the cephalic index among the various Christian groups: —

Cephalic Index	Tagalog	Caga-yan	Pan-gasinan	Pam-panga	Bisaya	Iloko	Bikol	Sambal	Total
80	1								1
81	3	2		1	1				7
82	4						2		6
83	6				3			1	10
84	4		1		1	4	1		11
85	2				3	2	1		8
86					4	1			5
Averages:	83	81	84	81	84.4	84.5	83.2	83	83.5

Among the Christians, the Cagayan and the Pampanga have the longest and the Bisaya and the Iloko the shortest heads. Again, there is a fairly large difference between the average of the Tagalog and the Bisaya.

In this character we have one of the principal objections to the explanation advanced by Barrows [1] to account for certain wild tribes, the Kankanai, Nabaloi, Ifugao, Ilongot, etc., as being a mixture of Malay and Negrito elements. The head of the wild tribes is almost invariably longer than the head of the Christian Malay and the Negrito of the same region. Of the

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[1] Barrows, (b).

sixty Negrito crania described by Koeze,[1] 90 percent are brachycephalic. It is difficult to understand how a cross between two short-headed groups would result in a long head. Of the several groups proposed by Barrows, the Ilongot are the only ones whose characters would, in any measure, justify this assumption. In the one instance where we have definite data on the intermixture of Negrito and Bisayan, the Negrito-metis of Montano, the cephalic index is very high, 86.0.

NASAL INDEX.

There are several serious objections to the nasal index as an expression of the proportions of the nose. In the first place, the measurements of both dimensions are very small and any error of observation seriously affects the average. Also, there is apparently no uniformity on the part of different observers in determining the upper limits of the nose. The point corresponding to the nasion is very vaguely defined and hard to find in some instances. The width of the nose is taken at the widest point on the alae by some observers and at the point where the nose joins the face by others. It will be readily seen that very slight differences in technique would appreciably affect the results. Consequently, we can make only a very general comparison of this character. A case in question is at hand. Groups of individuals, described as Bontok Igorot, have been measured by Jenks, Bean, and Kroeber. Bean records an average nasal index of 97.6, Kroeber one of 99.8, and Jenks an average of 79.2. It is very difficult to determine how much of the difference is in the individuals measured and how much in the technique. It may be partly both.

Barrows [2] quotes Topinard to the effect that the nasal index is: —

> . . . perhaps the most exact character for classifying races, all white races being leptorhinian, the yellow mesorhinian, and the black or negro races platyrhinian. Indeed, the presence of a markedly platyrhinian type of nose may almost be taken as clear proof of negro derivation.

In a loose sense, this is undoubtedly true, but we can by no means accept it as a law. It assumes the whole question at issue. The question as to whether or not the broad nose is necessarily always a Negroid characteristic is one of the big stumbling blocks in a universally satisfactory classification of the Australian natives and some of the inhabitants of southern Asia. At present, it is better to regard the nasal index, together with other anthropometric characters, as descriptive data, and decide racial affinities on a totality of the characters recorded.

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[1] Koeze.

[2] Barrows, (b), 360.

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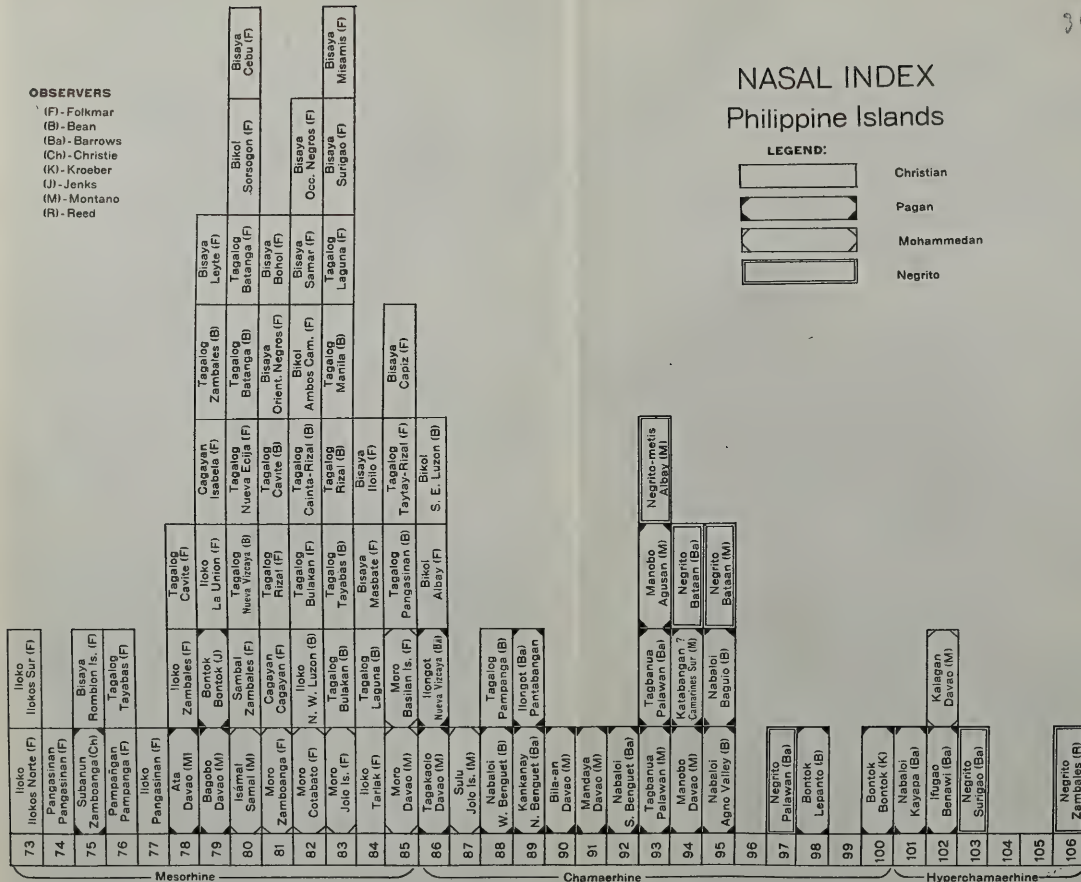

Fig. 3. The Nasal Index in the Philippine Islands.

Again in Fig. 3, I have placed each group above the numbers expressing the nasal index of that group. This presents also an asymmetrical curve. Even after removing the Negrito, the mode, (81–84), is far removed from the median (90). There is a minor mode at 93. The range of the entire group for this character is 34. Below we have summarized the seriation in groups of 5.

Nasal Index	Christian	Pagan	Mohammedan	Negrito	Total
70–74	3				3
75–79	10	4			14
80–84	29	0	4		33
85–89	6	5	3		14
90–94		8		2	10
95–99		3		2	5
100–104		3	1	1	5
105–109				1	1
Averages:	81.0	90.5	86.0	98	85

Again, we find the Christian groups clustering about one side of the curve confined to less than half the range for the entire groups. Each of the major groups presents a fairly definite curve. The Christians present an average of 81.0, the Pagans an average of 90.5, and the Negrito an average of 98.0. The Mohammedans present an average of 86.0, slightly above the average for the entire group and intermediate between the Christians and Pagans.

The range of this index among the Christian groups is best shown by the following seriation: —

Nasal Index	Tagalog	Cagayan	Pangasinan	Pampangan	Bisaya	Iloko	Bikol	Sambal	Total
73						2			2
74			1						1
75					1				1
76	1			1					2
77						1			1
78	1					1			2
79	1	1			1	1			4
80	4				1		1	1	7
81	2	1			2				5
82	2				2	1	1		6
83	5				2				7
84	1				2	1			4
85	2				1				3
86							2		2
87									0
88	1								1
Averages:	81.8	80.0	74.0	76.0	81.6	80.0	83.5	80.0	81.0

On the whole, there is more or less uniformity in the nasal index among the Christian groups. The average for the greater number of the groups deviates only slightly from the average for the entire group. The Pangasinan and Pampangan diverge most and have the smallest nasal index.

BODY WEIGHT AND INDEX OF ARM REACH.

The data furnished by Folkmar[1] on weight are the more interesting because this character is so rarely reported on. His observations were mainly on the Christian groups.

	Groups	Average Stature	Average Weight
(3)[2]	Bikol	158.6	54.4
(12)	Bisaya	159.0	52.0
(7)	Tagalog	160.0	53.0
(5)	Iloko	160.0	52.9
(1)	Sambal	161.0	54.9
(2)	Cagayan	161.5	55.9
(1)	Pampangan	162.0	53.6
(1)	Pangasinan	163.0	52.9

In general, the taller groups are heavier. There are a few exceptions in instances where only one provincial group is reported on. Stature and body weight are seriated below.

Kilograms	No. of Cases.	Centimeters	No. of Cases
48	2	155	1
49	1	156	1
50	1	157	0
51	2	158	5
52	8	159	9
53	7	160	5
54	3	161	6
55	2	162	2
56	3	163	1
57	2	164	1
58	0	165	0
59	1	166	1
Average:	53 kg.	Average:	160 cm.

[1] Folkmar.
[2] Numbers in ( ) refer to number of provincial groups included.

Considered as one group they are slightly lighter than certain other groups of similar stature for whom we have data.

	Stature	Weight	Observer
Trumai (S. A. Indian)	160	58.2	Ranke
Polish Jews	161	55.0	Elkind
Sundanese	159	51.5	Kohlbrugge
Anamite	159	51.3	Bonifacy

It is questionable in how far this character is comparable, since Folkmar's subjects were convicts.

Barrows [1] has placed emphasis on the value of the arm reach index in determining racial affinities. Speaking of the Negrito he says: —

> In every individual the extreme reach of the arms (Grande envergure) exceeded the stature. In men the excess varied from 30 mm. to 139 mm. and in the women from 23 mm. to 102 mm. This measurement shows the Negritos to have unusually long arms. In yellow races the arm-reach is about equal to the stature and in the white race it is usually a little above. I think we may take this excessive reach of arms to be a truly Negrito character.

This generalization is then used to support his explanation of the origin of the Nabaloi, Kankanai, Ifugao, and Ilongot. But this statement holds true only as a broad generalization. Excessive reach of arms as expressed by the index of arm reach does not necessarily express long arms. In some instances, it rather expresses wide shoulders. Barrows's argument may be met in two ways; first, by showing that racial types unquestionably non-negroid have a very high index of arm reach and secondly, by showing that certain of these pagan tribes showing other "Negrito-like characters" do not have a high index of arm reach.

The range of the average of this index is approximately from 99 to 109. The following partial list taken from Martin [2] will give some idea of its value as a test for Negroid intermixture.

Belgians	104.8
Trumai (Indian)	105.3
French	106.0
Aueto (Indian)	106.1
Bella Coola (Indian)	106.2
Lithuanians	106.6
Esths	108.0

Examination of the more complete table shows many more divergent cases. If we note the range of this index, as calculated from the average stature

[1] Barrows, (b), 359.
[2] Martin, (b).

and average arm reach recorded by Folkmar for the Christian groups, we see that it represents nearly the whole range of the index. In the majority of instances, the arm reach is considerably greater than stature.

On the other hand, the eighteen male Bontok Igorot measured by Kroeber [1] have an average arm reach index of 101.6, yet their nasal index, 99.8, is decidedly "Negroid". In the measurements recorded by Barrows the average index of arm reach would approximate very closely 103.

CORRELATIONS.

We have seen in the preceding tables (Figs. 1, 2, 3) that the respective curves for stature, proportions of the head, and proportions of the nose were asymmetrical. The Christian groups constituted the main curves and various other groups tended to cluster at the extremities. It now remains to determine whether or not these minor curves were made up of the same groups in each instance or, in other words, to determine whether a given group varied appreciably from the mean in one character or in several characters.

In Fig. 4 we have the correlation of the cephalic and nasal indices. If we bisect the correlation graph horizontally and vertically by a dotted line, we have four minor graphs representing equal portions of the range of these two indices. Section A would contain all groups with a nasal index above 90 and a cephalic index below 82; Section B would contain all groups with a corresponding range of nasal index and a cephalic index above 80; Section C would contain all groups with a nasal index below 91 and a cephalic index below 82; and in Section D we have all groups with a cephalic index of 81 and above, and a nasal index below 91. A glance at the graph (Fig. 4) shows us that all the Christian groups except number 31 (Tagalog of Cainta, Rizal) are within Section D as are also all the Mohammedan groups, except number 72. All of the Negrito groups are in Section B. In Section A, with the exception of number 72 (Kalagan) we have only Pagan groups. Near the border lines of Section A, we have six other Pagan groups, 63, 52, 60, 65, 68, and 54. Of the other Pagan groups number 51 (the Bontok of Bontok — Jenks) is isolated and numbers 69, 64, and 71 (the Bagobo, the Subanun, and Ata) stand interspersed among the Christian groups. In Section C, all of the groups are near the borders of Sections A and D except

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[1] Kroeber.

number 51, the Bontok of Jenks. The variability of the Christian groups covers nearly the entire range of Section D. Of those Christian groups for which we have measurements from several provinces, there is no tendency for one group to segregate in any one part of the section. The various groups overlap. Another point of interest is that besides a few Pagan groups which stand intermediate between the Negrito and Christians in these two

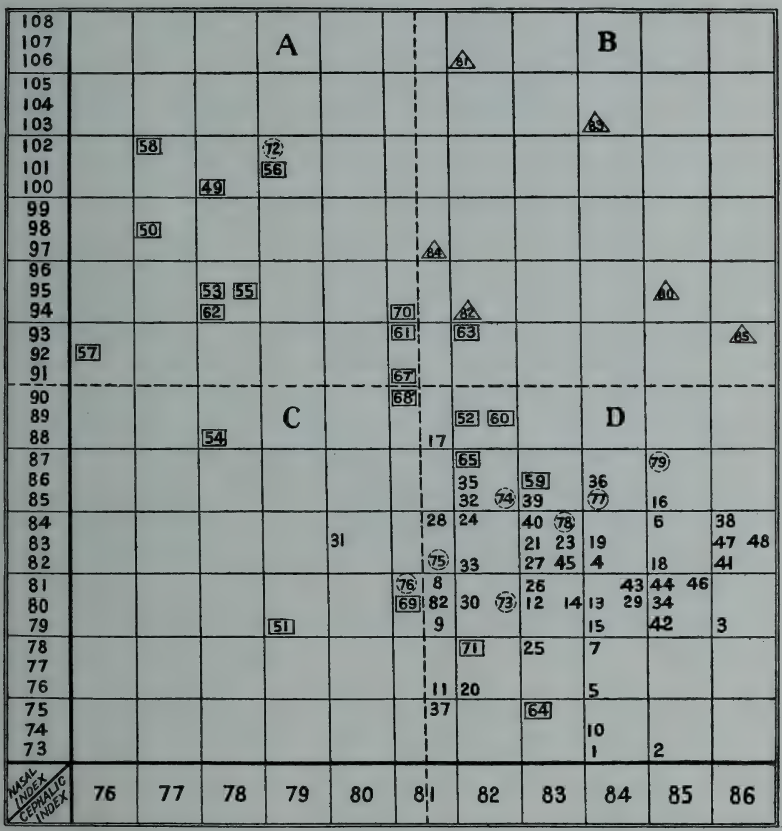

Fig. 4. Correlation of the Cephalic and Nasal Indices.

characters, there is another cluster of twelve or more groups in Section A which stand distinctly apart from both of these.

The relationship of the various groups may be shown by means of another diagram. We have data on stature, cephalic index, and nasal index for nearly every group. If we draw three lines of equal length representing

the range of these three characters, calibrate them at convenient intervals representing specific units of these measurements and indices, and place the ends in juxtaposition, we have a triangular correlation graph similar in principle to the rectangular graph used by Thompson [1] for craniometrical observations. When we connect the points on the three lines representing the stature, cephalic index, and nasal index of a given group, we obtain a second triangle within the first. Variability of the indices and measurements produce marked changes in the size, proportions of the sides, and orientation of the inner triangles. Fig. 5 shows the form of triangle presented by several racial types.

In Fig. 6 we have represented, by means of similar graphs, stature, cephalic index, and nasal index for all those Philippine groups on which we have measurements. This enables us to review the entire data at a glance. The numbers and symbols correspond to those used elsewhere in the text.

The first forty-eight triangles representing the Christian population are very similar. The base is towards the top and the sides tend to be equal. But numbers 49 to 58 representing the Pagan groups of Luzon present an entirely different form with a different orientation. Again, number 51 (Bontok of Jenks) is entirely different and numbers 59 and 60 (the Ilongot) present an intermediate form. Numbers 61, 62, and 63 approach the form presented by Numbers 49 to 58; number 64 is similar to the first group; numbers 65 to 70 are similar to numbers 49 to 58; numbers 71 and 73 to 79 are like the first group; while number 72 resembles numbers 49 to 58. Numbers 80 to 85, representing the Negrito, present a distinctive form of triangle. The triangle is much larger than those representing any of the other groups.

Roughly then, we have three forms of triangles. The similarities may be summarized as follows: —

	Type I	Type II	Type III
	Nos. 1 to 48	Nos. 49 to 58	Nos. 80 to 85.
	" 64	" 61 to 63	
	" 71	" 65 to 70	
	" 73 to 79	" 59 to 60?	
Total number of groups	57	20	6

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[1] Thompson.

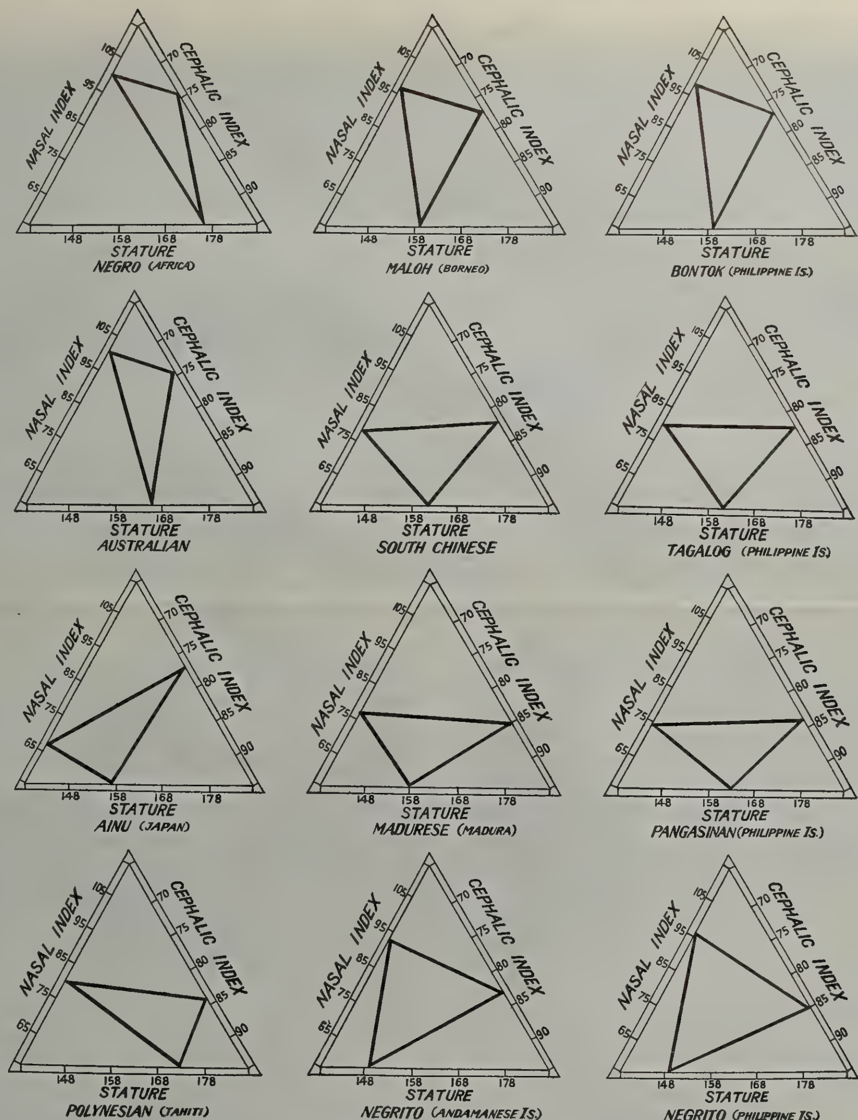

Fig. 5. Graphic Correlation of Stature, Cephalic and Nasal Indices of Miscellaneous Types.

GENERAL DISCUSSION.

Our conclusions should not be confused with our method. Throughout our review we have grouped the population of the Philippines into four groups: Christian, Pagan, Mohammedan, and Negrito, without any consideration of racial affinities, except in the case of the Negrito. Our purpose was twofold: in the first place, it afforded a convenient method of dealing rapidly with a fairly large series of observations, and in the second, it served as a basis for subdividing the population in our test for homogeneity or heterogeneity of racial type. We did not expect to find that there was any real correlation between Christianity, Mohammedanism, or Paganism and racial type. Assuming, however, that there were several racial types on the Archipelago, we should not expect to find them equally distributed among the three religious, or cultural groups. We would expect a certain association between physical types and culture groups to the extent that one group might contain a greater number of individuals representing one physical type and a lesser number of another. But so far as method is concerned, we might obtain similar results by geographical subdivisions. If, on the other hand, there was a homogeneity of racial types on the Islands, our subdivisions should have shown very similar averages for stature, head form, and nose form.

All our conclusions will be drawn directly from the data reviewed, and consequently will be far from conclusive. On several groups we have no observations and on many the observations are meager. More extended studies on several groups would, probably, considerably alter our conclusions. Then, too, we are dealing wholly with averages. The final conclusions on racial affinities in the Philippines must be based on more detailed and extensive studies. Finally, our characterization of racial types will define these types as they were at the time the observations were made with no speculation as to their original characteristics.

The data at hand would seem to indicate that the bulk of the population of the Philippine Islands may be included in three racial types each of which presents certain distinctive characteristics. These types may be characterized as follows:—

I. Malay.
 Affinities: distinctly Mongoloid.
 Hair: straight black.
 Skin: varying shades of brown.

Eyes: dark brown; Mongoloid fold common.
Head: very short; cephalic index 81 and above.
Nose: relatively narrow; nasal index below 88.
Stature: tallest groups on the islands; average about 160 cm.

Represented by:—

Iloko	Subanun
Pangasinan	Ata
Tagalog	Isamal
Bikol	Moro of Davao
Bisaya	Moro of Cotabato
Sambal	Moro of Zamboanga
Pampanga	Moro of Basilan Island
Cagayan	Moro and Sulu of Jolo Island
	Bagobo?

II. Indonesian.

Affinities: less Mongoloid than the Malay type.
Hair: straight and wavy black or dark brown.
Skin: varying shades of brown.
Eyes: dark brown, Mongoloid fold less common than among Malay.
Head: longest on islands; cephalic index mostly below 82.
Nose: short and wide; nasal index above 87.
Stature: short, but taller than Negrito; average about 156 cm.

Represented by:—

Bontok (Igorot)	Kalagan
Kankanai (Igorot)	Mandaya
Nabaloi (Igorot)	Katabangan
Ifugao	Kulaman?
Manobo	Ilongot?
Bilaan	Bagobo?
Tagbanua	

III. Negrito.

Affinities: Negroid.
Hair: woolly, kinky, black.
Skin: very dark brown.
Eyes: dark brown, wide open.
Head: short; cephalic index above 81.
Nose: short, low and wide; nasal index above 93.
Stature: very short; average 150 cm.

Represented by:—

Negrito of Zambales.
Negrito of Bataan.
Negrito (Batak) of Palawan.
Negrito (Mamanua) of Surigao.

The nature of the data do not warrant further subdivision into local groups. Future research may indeed alter the above scheme somewhat, yet it does not seem likely that it will alter the fact that, apart from the Negrito and Malay types, we have still a third type which we have chosen

to call Indonesian. The name Indonesian has been retained, although our definition of the type and classification of groups does not correspond to that of Montano,[1] Deniker [2] or Keane,[3] differing from each in several details. It might also be added that the three authors quoted above are not in agreement, one with the others.

It remains then to determine whether or not we are justified in regarding these groups as distinct racial types. The first and third types as defined need no justification. All observers are agreed that we have, in the Philippines, a group which we have called Malay although some prefer to call it "Malayan" or "Proto-Malay." These two latter names have been avoided for the reason that they are frequently used to designate an earlier Malay or Mongoloid element and also at times as synonyms of Indonesian. For the present, it seems best to use a non-committal name. All anthropologists are also agreed on the presence of a distinct Negrito type. The second type, or Indonesian, alone needs explanation.

It has been suggested that it may represent a very thoroughly fused Negrito and Malay stock. It differs from the Malay in having a longer head, slightly wavy hair, less Mongoloid eyes and in being shorter in stature. On the other hand it is taller than the Negrito, has a longer head, the hair is not woolly or kinky. However, it should be mentioned here that one of Martin's [4] most important conclusions in his recent survey of the whole Malay problem is that the Semang (Negrito) is differentiated from the Sakai by characters of hair alone and not by cranial proportions or skin color. But,[5] even if we were to interpret this to mean that there was a possibility of the Sakai representing a type intermediate between the Malay and the Semang, it would not help us to solve the Philippine problem as such. The Negrito of the Philippines do differ from the Indonesians in head form as well as in hair form and stature.

Again we have no certain evidence for a thorough fusion of types. In the light of our present knowledge of heredity, there are no grounds for assuming that two racial types would ever become completely fused in the sense of forming a new race. It most certainly is a possibility, but at the present time cannot be regarded as a probability.

The population of the various groups has been recorded in some detail. It would seem that the relative size of two groups would be a rather important consideration in discussing the probable effect of one group on

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[1] Montano.
[2] Deniker.
[3] Keane, (a), (b).
[4] Martin, (a).
[5] As suggested by Barrows, (b).

another. We have seen that the Malay type made up the greater part of the population, about nine-tenths of the total. Next in order of size, we have the Indonesian and lastly, the Negrito. The Negrito are almost a negligible quantity. The census actually records nearly twice as many foreign-born Chinese as Negrito. Of course, one cannot judge the past by the present, yet it seems fair to assume that for some few centuries, at least, some such relative ratio has held between the various groups. On the basis of numbers alone we should be justified in assuming that the Chinese and other foreign-born had exerted as much influence on the Malay and Indonesian types within recent times as did the Negrito. Again, on the basis of numbers alone, we should expect the Malay and Indonesian types to produce more effect on the Negrito than the reverse. Again, this statement may seem to contradict itself, yet such an interpretation seems justifiable. In the United States we have the various European racial types as well as the Negroes and Indians. The two latter types are in the minority. It is probably safe to say that the European types have affected the Negro and Indian types to a greater degree than have these latter the European types.

This introduces another factor which should be considered in stating the effect of one racial type or even local type upon another. There are usually certain prejudices or social barriers which interfere with, even if they do not wholly prevent, equal reciprocity in such matters. Such factors do not necessarily prevent intermarriage, but usually result in those intermarrying living more often among one group than the other. Naturally, the results of such a practice would be to produce a greater apparent change of type in the first group. No implication of anything of the sort is revealed in the writings on the Philippines. Very frequently references are made to Negrito living among the Malay and Indonesian peoples. Yet, they are always overwhelmingly in the minority. That the Negrito, as well as the Chinese, have had a marked effect on the population of the Philippines, especially in some localities, no one would doubt, but at the present it seems extremely doubtful that they can be used as an explanation of the racial diversity of many groups. The conclusive solution of this problem cannot be obtained from mere averages. It would necessitate a very thorough study of the suspected groups and involve a correlation of the various characters.

Another possibility is that the Indonesian type might represent a local type separated from the Malay stock on the spot. This also may be regarded as within the range of possibility. Yet it hardly seems necessary to postulate such an hypothesis when we have a similar type occurring nearby. Let us now consider the distribution of types in other parts of the Malay Archipelago.

Related Types in Malaysia.

It is not our purpose to review in detail the anthropometric data for the entire Malaysian Archipelago. In fact, so far as the present data permit, this has already been done by specialists in the several separate parts of the region. We shall simply summarize the conclusions of the later contributors and present some comparative data in an endeavor to show the racial affinities of the inhabitants of the Philippines.

Borneo.

Considering the data in geographical order we turn first to Borneo. In a brief note in "The Pagan Tribes of Borneo," A. C. Haddon [1] has very conveniently summarized the results of the anthropometric observations of the Cambridge Expedition to Sarawak and those of A. W. Niewenhuis in Netherlands Borneo. Dr. Haddon finds evidence of a short-headed group which he prefers to call Proto-Malayan in origin and a long-headed group which he terms Indonesian in origin. Hose and McDougall [2] have contributed a wealth of valuable material and Dr. Hose has made a detailed classification of the peoples of Sarawak. In the same year Garrett [3] contributed some valuable data on the peoples of Borneo and Java. Below is a summary of the same characters which we employed in reviewing the peoples of the Philippines. The hair is black or very dark brown in color. The skin and eyes are varying shades of brown. Only the averages of the men are given.

Borneo.

No. of Cases	Group	Hair	Skin [7]	Eyes [8]	Stature	Cephalic Index	Nasal Index
6	Orang Balik Papan [4]	straight	4–5–6	2–3	1535	83.5	87.6
6	Orang Bulongan [4]	straight or wavy	4–5–6	2–3	1577	86.1	84.5
7	Milanau [5] ([6])	"	6–14–12	Mongol fold present	1562	84.2	83.0
14	Sibuyan [5]	"	——	——	1543	83.1	81.8
5	Sabop [5]	"	12–17	——	1540	75.3	83.3
42	Land Dayak (Klementan [5])	"	25		1577	78.4	86.3
8	Long Kiput [5]	"	14–12–17	trace of fold	1565	80.6	92.5

[1] Haddon.
[2] Hose and McDougall.
[3] Garrett.
[4] Garrett.
[5] Hose and McDougall.
[6] Head deformation noted.
[7] Numbers refer to von Luschan's standard color scale.
[8] Numbers refer to Martin's standards.

No. of Cases	Group	Hair	Skin [1]	Eyes [2]	Stature	Cephalic Index	Nasal Index
8	Long Pokun [3]	straight or wavy	12–17	trace of fold	1590	76.9	88.2
10	Lerong [3]	"	12–14–6	"	1520	78.5	86.5
33	Banjerese [4]	"	4–5–6	2–3	1569	81.5	88.0
19	Punan [3] [(5)]	"	14–12–17	slightly oblique	1550	80.9	88.1
56	Iban (Sea Dayaks) [3]	"	6–14–17	fold in 20%	1585	83.0	93.9
26	Kenyah [3]	"	6–16–14	trace of fold	1608	79.9	92.7
43	Kayan [3]	"	brown	no fold	1570	81.1	——
26	Ulu Ayars (Dayaks) [3]	"	light brown	"	1551	74.7	——
14	Punan [3]	"	"	"	1569	81.3	——
7	Maloh [3]	wavy	17	——	1585	76.8	97.4
12	Barawan [3]	straight or wavy	14–12–17	trace of fold	1540	77.8	89.1
16	Malang [3]	wavy	12–14–17	dark brown	1535	76.9	88.2
21	Kayan [3]	"	14–17	"	1550	79.8	91.6
4	Murut [3]	"	12–14	"	1590	77.5	99.0
7	Kalabit [3]	"	12–14	"	1565	78.5	91.5

Again, for purposes of analysis, let us treat the groups as individuals and seriate the results on stature, the cephalic index, and the nasal index.

Stature	Groups	Cephalic Index	Groups	Nasal Index	Groups
152 cm.	1	75	2	82	1
153	0	76	0	83	2
154	5	77	4	84	1
155	3	78	4	85	0
156	3	79	1	86	2
157	3	80	2	87	0
158	3	81	4	88	5
159	3	82	1	89	1
160	0	83	2	90	0
161	1	84	2	91	0
		85	0	92	3
		86	1	93	1
				94	1
				95	0
				96	0
				97	1
				98	0
				99	1

[1] Numbers refer to von Luschan's standard color scale.
[2] Numbers refer to Martin's standards.
[3] Hose and McDougall.
[4] Garrett.
[5] Head deformation noted.

The groups represented are all of short stature, longer headed in the main than the inhabitants of the Philippines and there is a tendency for the nasal index to be high. Diligent search has revealed no Negrito element in Borneo. There are said to be great numbers of people from China and India and other parts of the mainland as well as from the rest of the Archipelago. According to the above table, we have again a long head correlated with a broad nose and short stature. There are also combinations of short and long heads with a lower nasal index.

Celebes Islands.

Our knowledge of the natives of Celebes is based chiefly on the researches of Fritz and Paul Sarasin.[1] Garrett's[2] observations include a few Bugi while Ten Kate[3] has published on the Bugi and Macassar. Some of the measurements are listed below:—

No. of Cases	Group	Hair	Skin	Eyes	Stature	Cephalic Index	Nasal Index
24	Bugi and Macassar[4]	straight wavy	30–44 Broca		1623	82.1	85.9[7]
6	Bugi[5]	straight wavy	4–5–6	2–3	1544	83.4	87.5
9	Bugi[6]	——	——	——	1568	87.0	86.0
12	Macassar[6]	——	——	——	1615	86.2	84.4
12	Toala[4]	curly	29–30 Broca		1575	80.4	99.5[7]
5	Tomuna (Muna)[4]	curly	"		1576	84.5	102.4[7]
11	Tokea[4]	curly	"		1570	83.2	99.8[7]
10	Toradja[4]	straight wavy	"		1598	81.3	97.8[7]
6	Tomekongka[4]	straight wavy	30–34 Broca		1569	81.8	90.0[7]

As a whole, the groups are slightly taller than those of Borneo. Sarasin[8] distinguished three types: a Toala type including the Toala, the Tokea, and the Tomuna; a Toradja type including the Toradja, the Bugi, the Macassar, and the Tomekanga; and the Minahasser. In the Toala group

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[1] Sarasins.
[2] Garrett.
[3] Ten Kate, (a).
[4] Sarasins.
[5] Garrett.
[6] Ten Kate, (a).
[7] Sarasins calculated the nasal index from photographs.
[8] Sarasins.

it seems we have a type different from any so far described and resembling the Sakai or Senoi and certain other types which we shall discuss later. This group is distinguished chiefly by the predominance of wavy or curly hair. The following types of hair form are quoted from Sarasin [1]:—

Flachwelliges	Low waves	3.7%
Hochwelliges	Deep waves	70.4%
Engwellig-lockiges	Closely curled	25.9%

All of the other peoples have straight or slightly wavy hair. Yet, even among the straight-haired groups, we have the tendency towards a long head and a broad nose. The Bugi and Macassar have the shortest heads, narrowest noses, and higher stature. The group with curly hair will be referred to again. It should be stated here that no Negrito or Papuan groups have been encountered on Celebes.

Java.

In Java we shall present only the observations of Hagen,[2] Kohlbrugge,[3] and Garrett [4] which may be taken as representative.

No. of Cases	Group	Hair	Skin	Eyes	Stature	Cephalic Index	Nasal Index
17	Javanese [4]	straight	4–5	2–3	1570	85.0	85.7
56	Javanese [2]	"	21 Broca	Mongol fold 52%	1617	84.4	83.0
37	Sundanese [4]	"	4–5–6	2–3–4	1591	85.5	86.9
17	Sundanese [2]	"	21 Broca	Mongol fold 53%	1588	86.5	81.8
105	Tenggerese [3]	wavy	32–33 Broca	——	1600	79.7	100.4
10	Madurese (Madura[2])	straight	21 Broca	Mongol fold 33%	1581	85.0	77.0
7	Batavian Malay [4]	"	4–5	3	1634	85.5	86.2

The stature is still low, yet, as a whole, the groups are slightly taller than the groups of Borneo and more like those of Celebes. We are also struck by the decided short-headedness of nearly every group. On the whole, the nasal index is also much lower. Yet, there is one exception — the Tenggerese mountaineers exhibit a longer head and a short broad nose. The hair also is wavy. In stature they are nearly as great as the other groups.

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1 Sarasins.
2 Hagen, (b).
3 Kohlbrugge.
4 Garrett.

Here we may also mention a recent publication of Kleiweg de Zwaan [1] on the inhabitants of the Island of Nias near Sumatra. Some 1300 individuals were studied and measured. The mean stature was approximately 154.7, cephalic index 80.7, and nasal index 78.0. In an analysis and correlation of the measurements, it was found that the shorter individuals had lower cephalic indices and higher nasal indices. This is not the natural correlation we should expect according to our knowledge of growth. It is to be hoped that more extensive studies of this nature will be made in other parts of the Archipelago.

Sumatra.

Again, in Sumatra, Hagen [2] has contributed the greater part of the available data. His observations follow:—

No. of Cases	Group	Hair	Skin	Eyes	Stature	Cephalic Index	Nasal Index
40	Batak [2]	straight wavy	21 Broca	Mongol fold 43%	1599	80.3	88.5
23	Delimalayan [3]	straight	21 Broca	Mongol fold 80%	1622	82.3	81.0
18	Menangkabau [2]	"	"	Mongol fold 43%	1599	80.1	81.0
20	Orang Kubu [3]				1587	78.5	89.0

The Batak and Orang Kubu have the higher nasal indices and longer heads. Hagen [3] distinguished two types among each of these groups, a long-headed group and a short-headed group.

Malay Peninsula.

In the Malay Peninsula we have had a score of workers. Of these we shall consider only the more recent contributions by Annandale and Robinson,[4] Skeat,[5] Duckworth,[6] Martin,[7] and Skeat and Blagden.[8] These works furnish an extensive bibliography and discussion of the whole Malay problem.

Racial affinities in Malay have been rather obscure and may still be con-

[1] Kleiweg de Zwaan.
[2] Hagen, (b).
[3] Hagen, (c).
[4] Annandale and Robinson.
[5] Skeat.
[6] Duckworth, (a).
[7] Martin, (a).
[8] Skeat and Blagden.

sidered uncertain, but the recent works of Martin and Skeat have thrown considerable light on the matter. Martin's conclusions may be summarized in the following classification.

I. Ulotrichi, or Woolly-haired group.
   1. Semang (Mendi or Menik) in the west of northern Perak and in Kedah.
   2. Pangan in the east of Kelantan and Patani.

II. Cymotrichi, or Wavy-haired group.
   Senoi (or Sakai) in southern and eastern Perak and in northwestern Pahang.

III. Lissotrichi, or Smooth-haired group. (Mixed race with primitive Malay base.)
   1. Blandas } in southern Selangor.
   2. Besisi }
   3. Mantra in Rembau and Malacca.
   4. Jakun in Johore.

Skeat's[1] conclusions, based upon his own observations and to some extent on the conclusions of Martin, are very similar. His classification is more committal on the third group, which he calls the Jakun group, and subdivides as follows:—

1. Tribes of Semang origin: Kenaboi? and Udai?
2. Tribes of Sakai origin: Blandas and Berembuns?
3. Jakun or Malayan aborigines:
   (a) Orang Bukit (Land or Hill Jakun)
   (b) Orang Laut (Sea Jakun)

Data from representative tribes are presented approximately in the same order as the above classification presents these tribes:—

Malay Peninsula.

No. of Cases	Tribes	Hair	Skin	Stature	Cephalic Index	Nasal Index
5	Semang (Perak)[2]	woolly	28–29–43 Broca	1549	77.9	83.5
20	Semang (Perak)[3]	"	——	1520	77.9	97.0
9	Sakai (Jehehr)[3]	wavy or curly		1542	77.6	95.4
10	Sakai (Po-Klo)[3]	"		1545	78.1	95.7
18	Senoi I (S. W. Perak)[2]	wavy	28–29–43 27–22 Broca	1547	80.0	85.8
7	Senoi II (Tapah)[2]	"	"	1495	76.4	84.7

[1] Skeat. [2] Martin, (a). [3] Annandale and Robinson.

No. of Cases	Tribes	Hair	Skin	Stature	Cephalic Index	Nasal Index
9	Senoi III (West Perak)[1]	wavy		1548	77.2	85.2
6	Eastern Senoi [1]	"	Broca	1543	77.6	83.3
34	Sakai (Mai Darat) [2]	"	——	1565	79.5	88.0
13	Orang Belanus [3]	straight or wavy	——	1562	77.7	81.5
8	Mantra (Negri Sembilan) [1]	"	"	1485	78.8	76.8
10	Blandas (Selangor) [1]	"	"	1543	77.1	76.6
14	Besisi [1]	"	"	1533	82.4	78.9
15	Orang Laut Islam [2]	straight	yellowish brown	1602	83.7	86.9
36	Malay (South Perak) [2]	"	"	1594	82.3	80.9
135	Malay (East Coast) [2]	"	"	1597	82.7	82.6

The Semang is a pygmy negroid type usually classified with the Negrito of the Philippines and the inhabitants of the Andaman Islands. The head of the Semang is slightly longer than that of the other two groups mentioned.

Apart from the Negrito, Martin has established as a separate type the wavy or curly-haired Senoi or Sakai. A comparison of the measurements of Martin and Annandale and Robinson suggests that there is a difference in the technique in the nasal measurements. The Sakai of Annandale have long heads and a short broad nose. The Senoi of Martin have a long head and a slightly narrower nose. Martin sees in them certain resemblances to the Veddah of Ceylon and the Toala of the Celebes.

Skeat has suggested the following tentative classification:—

I. Negrito:
   - Andamanese
   - Philippine Negrito
   - Semang or Pangan
   - African Pygmy

II. Dravido-Australian:
   - Vedda of Ceylon
   - Tamil
   - Australian [4]
   - Sakai or Senoi

III. Malayan:
   - Jakun
   - Malay

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[1] Martin, (a).

[2] Annandale and Robinson.

[3] Knocker.

[4] This assumes the Australian Blacks to be non-homogeneous and refers to the Dravidian type.

These conclusions complicate matters somewhat. They raise the question as to whether or not we are dealing with four, rather than three, types. Are the Sakai or Senoi and related groups — the Vedda, Toala, and Australian — the same as the type which we have regarded as Indonesian? It seems doubtful, at least it is difficult to read Vedda, Tamil, or Australian affinities into the Bontok, Kankanai, Nabaloi and other Philippine tribes which we have called Indonesian. Martin, Sarasin, and others prefer to refer to this group as a pre-Dravidian type and regard them as the true aborigines of the Archipelago.

In summarizing the findings of somatological investigations in Malaysia the following facts should be borne in mind and the conclusions weighted accordingly. While we have data on a great number of widely distributed tribes there are many less accessible tribes that have not yet been studied. In the great majority of instances we have observations on only a very small number of individuals from each tribe. In even a greater number of cases, we have only averages recorded. Differences in technique may lead to a faulty interpretation in specific cases. Yet the nature of the data, as a whole, permits of some tentative conclusions which, perhaps, should be regarded as propositions awaiting confirmation or the reverse.

SUMMARY.

Turning first to the Philippines we found that aside from the possible influence of Chinese, Japanese, European, and other foreign elements, there was evidence for the existence of three fairly distinct racial types: Negrito, Indonesian, and Malay. The Negrito type we found again in the Malay Peninsula and in the Andamanese Islands. The two non-negroid types, Indonesian and Malay, we found in Borneo, Celebes, Java, Sumatra, and possibly in the Malay Peninsula. Besides these three types, there was found evidence of another type in the Sakai or Senoi of the Malay Peninsula and in the Toala of Celebes. This last type is regarded by investigators, who have studied them on the peninsula, as the true aboriginal inhabitants of the Archipelago. The data so far as published do not reveal the presence of this pre-Dravidian type in the Philippines, at least in any significant numbers or as a distinct group.

Racial affinities in the Malay Archipelago may be summarized in the following order. As a basis we have a pre-Dravidian element in the Sakai, Senoi, Toala, Vedda of Ceylon and Tamil; second, a scattered Negrito

group in the Negrito of the Philippines, Semang and Pangan of the Malay Peninsula, and the Andamanese Negrito; third, an Indonesian type represented by the Bontok, Nabaloi, Kankanai, Ifugao, etc., of the Philippine Islands, the Ulu Ayars (Dayak), Murut, Kalabit, Kayan, Maloh, etc., of Borneo, the Tenggerese of Java, Toradja and Tomekongka of the Celebes, the Batak and the Kubu of Sumatra, and possibly some of the mixed tribes of the Malay Peninsula; and finally, a fourth type in the Malay people who, for the most part, inhabit the coast regions of the various islands and Malay Peninsula.

No one would claim that the racial relationships in the Archipelago were as simple as the above summary might suggest or that any one of the tribes mentioned was purely the representative of one racial type. Assuming these racial types to exist we can only say that a given tribe listed as Malay, Indonesian, etc., is predominatingly of that type. Individuals of a different racial type may also be present and in some instances in sufficient numbers to obscure the racial affinities of the tribe. For the same reason, it is impossible at present to give a more accurate definition of the various types.

As to the broader affinities of these four types, there is some room for differences of opinion. As a working basis, it is probably better to treat each group separately for the present. But the ultimate purpose of anthropology is to trace the phylogenetic relationships of the various racial types of man. The real difficulties lie in defining the larger subdivisions or primary races. Obviously, a classification of mankind which will satisfy a majority of anthropologists cannot be made until we have gained a more thorough knowledge of racial types and have learned how to weight the various criteria. If we accept tentatively a classification of mankind into four main branches: Mongoloid, Negroid, European, and Australian, the affinities of the various groups to one another may be more clearly stated.

It has been suggested that the first type, Sakai or pre-Dravidian, is related to the Australian type. In view of the fact that we know so little of the Australian aborigines, it is, perhaps, better to regard this as a suggestion. Specialists have linked the Negrito with the Papuan and African pygmies in the Negroid division of mankind. As to the Indonesian type, I believe the totality of its characters suggest Mongoloid affinities, although less pronounced than those of the Malay. At least it seems fair to say that its Caucasian characteristics are in the minority and remain to be demonstrated. The Malay type shows a majority of undoubted Mongoloid characteristics.

Finally, in regard to the theories of migration accounting for the apparent stratification of the population in the Philippines, it should be stated

that such a problem cannot be definitely solved from anthropometric data. That we can account for the population of the Islands by two or three migrations of relatively pure racial types seems hardly probable. In our consideration of the geographical relationship of the Philippines we saw that these islands were connected by three partly submerged isthmuses with Borneo and Celebes and in turn closely linked with Java, Sumatra, and the mainland of Asia. Similar racial types were found in these Islands. Groups representing the three main types in varying degrees of purity and intermixture have probably entered the islands by different routes and at widely separated time intervals. That such an explanation is the more plausible is undoubtedly true, especially for those groups which we have called Malay. It seems fairly certain that the Malay type represents a more or less continuous influx extending over a long period of time. The present apparent stratification of the population in the Philippine Islands and elsewhere in the Malay Archipelago may be the direct reflection of the great predominance in numbers of the Malay type.

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Ethnic Groups

The numbers in this list are the same as used on Map 2 and Fig. 6.

Christian ○

1. Iloko — Ilokos Norte (F)
2. Iloko — Ilokos Sur (F)
3. Iloko — La Union (F)
4. Iloko — N. W. Luzon (B)
5. Iloko — Pangasinan (F)
6. Iloko — Tarlak (F)
7. Iloko — Zambales (F)
8. Cagayan — Cagayan (F)
9. Cagayan — Isabela (F)
10. Pangasinan — Pangasinan (F)
11. Pampangan — Pampanga (F)
12. Sambal — Zambales (F)
13. Tagalog — Nueva Vizcaya (B)
14. Tagalog — Nueva Ecija (F)
15. Tagalog — Zambales (B)
16. Tagalog — Pangasinan (B)
17. Tagalog — Pampanga (B)
18. Tagalog — Bulakan (F)
19. Tagalog — Bulakan (B)
20. Tagalog — Tayabas (F)
21. Tagalog — Tayabas (B)
22. Tagalog — Rizal (F)
23. Tagalog — Rizal (B)
24. Tagalog — Manila (B)
25. Tagalog — Cavite (F)
26. Tagalog — Cavite (B)
27. Tagalog — La Laguna (F)
28. Tagalog — La Laguna (B)
29. Tagalog — Batangas (B)
30. Tagalog — Batangas (F)
31. Tagalog — Cainta-Rizal (B)
32. Tagalog — Taytay-Rizal (B)
33. Bikol — Ambos Camarines (F)
34. Bikol — Sorsogon (F)
35. Bikol — Albay (F)
36. Bikol — S. E. Luzon (B)
37. Bisaya — Romblon I. (F)
38. Bisaya — Masbate (F)
39. Bisaya — Capiz (F)
40. Bisaya — Iloilo (F)
41. Bisaya — Samar (F)
42. Bisaya — Leyte (F)
43. Bisaya — Cebu (F)
44. Bisaya — Oriental Negros (F)
45. Bisaya — Occidental Negros (F)
46. Bisaya — Bohol (F)
47. Bisaya — Surigao (F)
48. Bisaya — Misamis (F)

Pagan □

49. Bontok — Bontok (K)
50. Bontok — Lepanto (B)
51. Bontok — Bontok (J)
52. Kankanai — N. Benguet (Ba)
53. Nabaloi — Agno Valley (B)
54. Nabaloi — W. Benguet (B)
55. Nabaloi — Baguio (B)
56. Nabaloi — Kayapa (Ba)
57. Nabaloi — S. Benguet (Ba)
58. Ifugao — Benawi (Ba)
59. Ilongot — Nueva Vizcaya (Ba)
60. Ilongot — Pantabangan (Ba)
61. Katabangan — Camarines Sur (M)
62. Manobo — Davao (M)
63. Manobo — Agusan (M)
64. Subanun — Zamboanga (Ch)
65. Tagakaolo — Davao (C)

65′. Tagakaolo — Davao (M)

66. Kulaman — Davao (C)
67. Mandaya —Davao (C)

67′. Mandaya — Davao (M)

68. Bilaan — Davao (C)

68′. Bilaan — Davao (M)

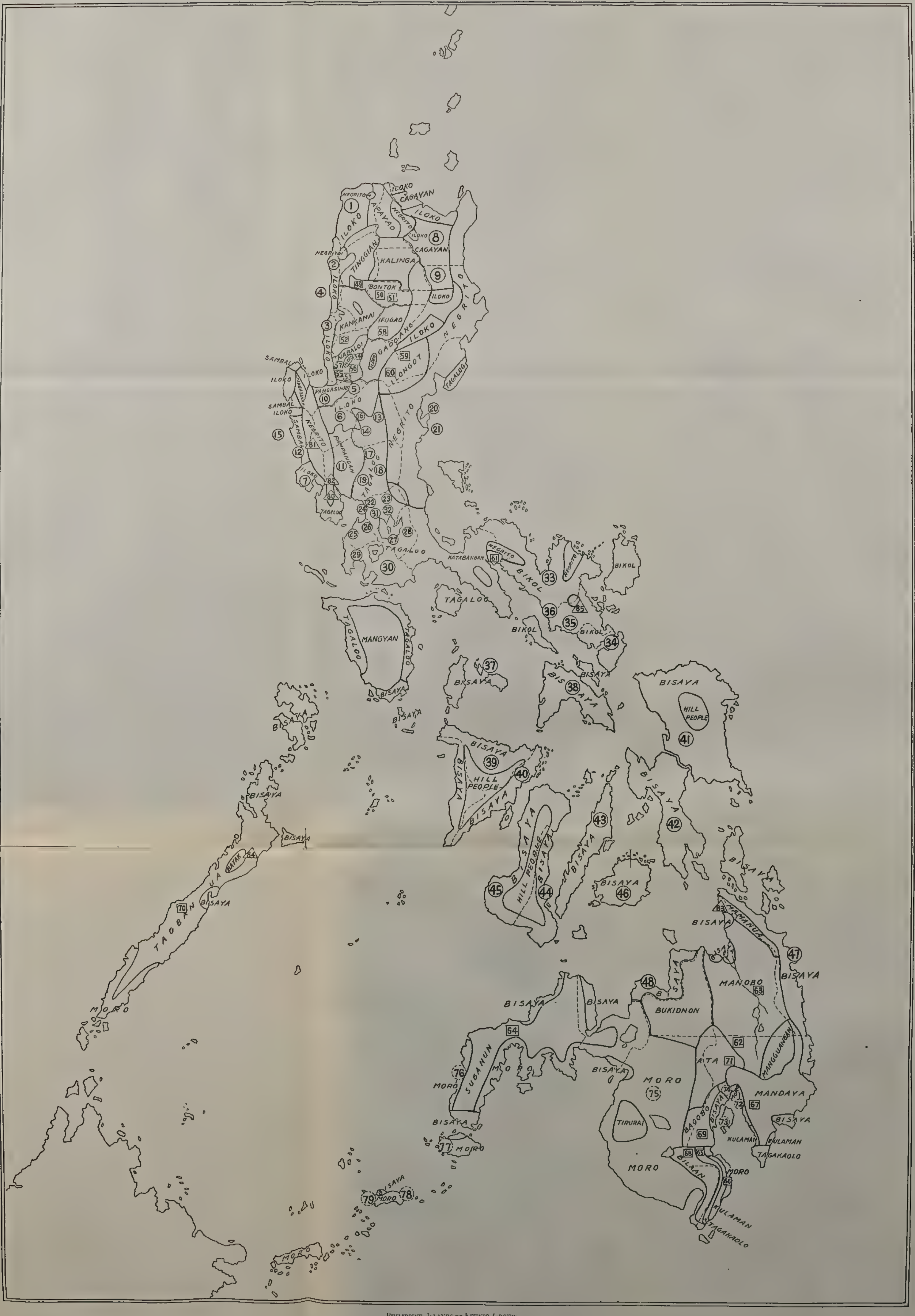
69. Bagobo — Davao (C)

69′. Bagobo — Davao (M)

70. Tagbanua — Palawan (Ba)
71. Ata — Davao (M)

Mohammedan ◌

72. Kalagan — Davao (M)
73. Isamal — Samal I. (M)
74. Moro — Davao (M)
75. Moro — Cotabato (F)
76. Moro — Zamboanga (F)
77. Moro — Basilan I. (F)



Philippine Islands — Ethnic Groups.

------- Boundaries of Provinces. ——— Boundaries of Ethnic Groups.

The numbers on this map indicate the position of the ethnic groups listed on p. 60 and also correspond to the numbers used in the text The location of the various groups is approximate

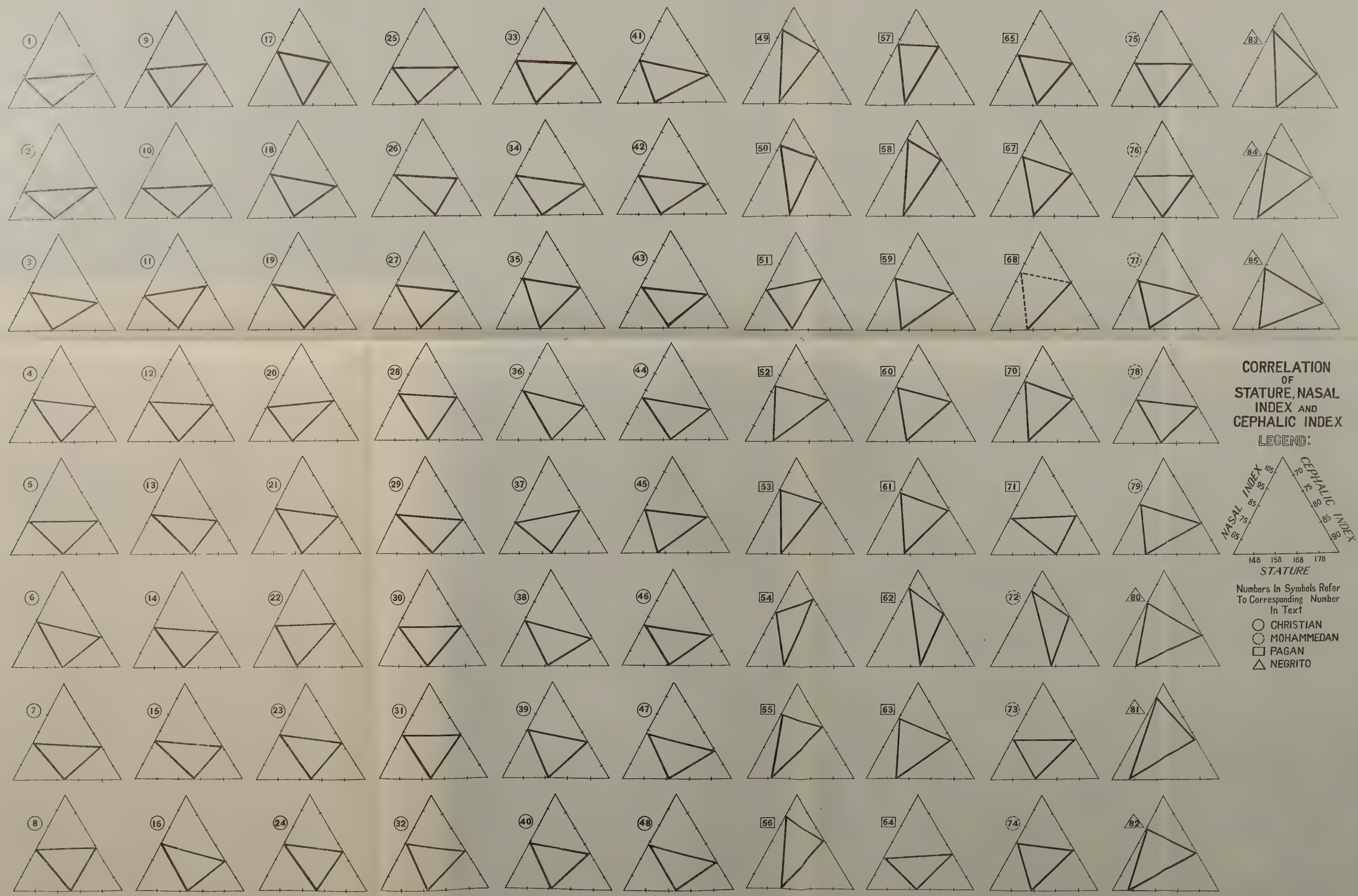


Fig. 6. Graphic Correlation of Stature, Cephalic and Nasal Indices for Philippine Types.

78. Moro — Jolo I. (F)
79. Sulu — Jolo I. (M)

Negrito △

80. Negrito — Bataan (M)
81. Negrito — Zambales (R)
82. Negrito — Bataan (Ba)
83. Mamanua — Surigao (Ba)
84. Batak — Palawan (Ba)
85. Negrito — metis — Albay (M)

Observers

B = Bean
Ba = Barrows
C = Cole
Ch = Christie
F = Folkmar
J = Jenks
K = Kroeber
M = Montano
R = Reed

ANTHROPOLOGICAL PAPERS
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VOL. XXIII, PART II

THE EVIDENCE AFFORDED BY THE BOSKOP SKULL OF A NEW SPECIES OF PRIMITIVE MAN (*HOMO CAPENSIS*)

BY

R. BROOM

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THE EVIDENCE AFFORDED BY THE BOSKOP SKULL OF A NEW SPECIES OF PRIMITIVE MAN (*HOMO CAPENSIS*).

By R. Broom.

ILLUSTRATIONS.

TEXT FIGURES.

THE EVIDENCE AFFORDED BY THE BOSKOP SKULL OF A NEW SPECIES OF PRIMITIVE MAN (*HOMO CAPENSIS*).

Four years ago there were discovered near Boskop, Transvaal, South Africa, some human remains which prove to be of the very greatest interest. The bones were found in a surface lateritic deposit while a trench was being cut. By singular good fortune a dispute arose between two farmers as to whether the remains were human, and the skull-cap was shown to Mr. F. W. FitzSimons of the Port Elizabeth Museum with a view to settling a bet. Mr. FitzSimons at once recognized the extreme importance of the discovery and persuaded the farmer to present the remains to the Port Elizabeth Museum.

The specimen just obtained consists of the greater part of both frontals and parietals with a small part of the occipital; the farmer admits having thrown away, most unfortunately, some portions which he thought unimportant. These latter were most probably further portions of the occiput which shows a fresh fractured margin.

Excavations at the spot of the find resulted in the discovery of the nearly perfect right temporal bone, most of the horizontal ramus of the left mandible, and a number of fragments of limb bones.

The bones are all completely mineralized, all the interstices being filled with laterite.

We have little or no clue to the age of the remains, as there are no associated fossil animals, and the associated chipped stones are not, in the opinion of Dr. Peringuey, of human workmanship, but we can quite confidently state that the remains are very ancient.

In a letter to "Nature" (5th Aug., 1915) Mr. FitzSimons gave three small photographic views of the skull-cap and compared it with that of Neanderthal man. He admits, however, that "this Boskop man differs from the typical Neanderthal type in having a lesser development of the frontal sinus, and a somewhat greater development of the forehead," indicating "that the Boskop man was of the Neanderthal race, but more advanced in intelligence than the type specimen." He also holds that "the discovery of this skull offers an explanation of the origin of the Palæolithic implements which are scattered in such vast profusion all over South Africa."

Appended to Mr. FitzSimons' letter is a note by Professor A. Keith, who, unfortunately, had only seen the rather unsatisfactory photographs, in which he expressed the opinion that "the photographs of the skull-cap reveal none of the characteristic features of Neanderthal man." He considers that "the individual to whom the skull-cap belonged was apparently of the modern type, with a head of remarkably larger dimensions."

The remains were submitted to Dr. L. Peringuey of the South African Museum for further examination, and there has just recently been issued a paper entitled "Preliminary Note on the Ancient Human Skull Remains from the Transvaal. By S. H. Haughton, Assistant Director, South African Museum. With Notes appended on Fragments of Limb Bones, by R. B. Thomson; and Fragments of Stone, by L. Peringuey, Director South African Museum."[1]

Mr. Haughton has carefully examined the skull remains and discusses their affinities at considerable length. The conclusions to which he comes may be given in the words of the published abstract of the paper: —

> The skull-cap is the longest known with the exception of that of La Chapelle aux Saints. Its greatest affinities are with the skulls of the Cro-Magnon type — a Negroid type which lived in Southern Europe after that of Neanderthal. The back of the skull is elongate a feature displayed both by Neanderthal man and the Cro-Magnon man, while the forehead and anterior half of the skull agree with the Cro-Magnon and Bantu types, and not at all with the Neanderthal. The temporal bone is primitive in its characters and seems to indicate a more degenerate type than does the skull-cap, a semblance which may be due to sex. The lower jaw is small and akin in characters to that of the Bantu or Bushman type.

At the meeting of the Royal Society of South Africa, where Mr. Haughton's paper was read, Dr. Peringuey expressed the opinion that "it was clear that the Boskop man had no connection with the Neanderthal race" but "as to the real importance of these remains there could be no doubt."

Appended to Mr. Haughton's paper is a "Note upon the Endocranial cast obtained from the Ancient Calvaria found at Boskop, Transvaal" by Professor G. Elliot Smith.

Unfortunately, Elliot Smith had not seen the original remains and the cast submitted to him was apparently only that of the upper part of the skull. He has, however, come to one or two interesting conclusions. He points out that the cranial cast in "maximum length attains the remarkable figure of 197 mm." and that the maximum breadth must have been at least 143 mm. The following are his principal conclusions which, of course, he states guardedly, owing to his not having seen the actual skull.

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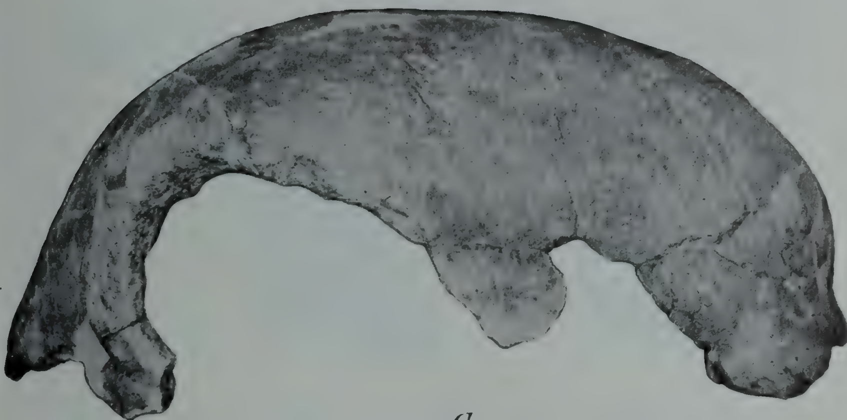
[1] *Transactions, Royal Society South Africa*, vol. 6, pt. 1, 1917.



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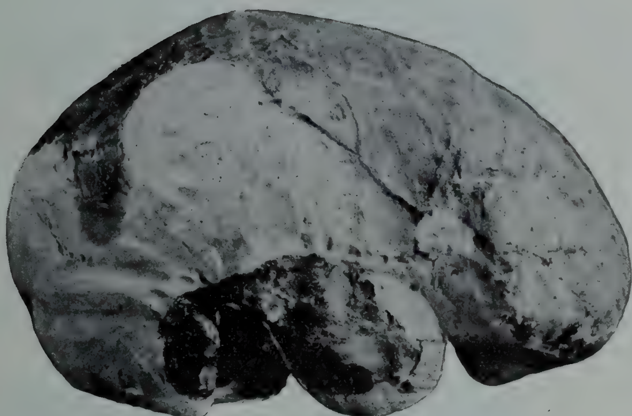

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Fig. 1. *a*, Side View of Calvaria of Boskop Skull. 53/100 Nat. size. *b*, Restoration of Cranial Cast of *Homo capensis*. 42/100 Nat. size.

Fig. 2. Views of Jaw Fragment of Boskop Skull. Nat. size. X-ray Photograph of Jaw, viewed at right angles to ramus.

Its great size no less than its distinctive configuration present a marked contrast to the condition found in the modern inhabitants of South Africa. Its features present a curious blend of those which are regarded as distinctive of Mousterian and Aurignacian types of men respectively; but whereas the general form presents certain resemblances to the former, in all essential respects the cast conforms to the type represented by the Cro-Magnon man of Western Europe.

It must not be assumed however that the Boskop man necessarily belongs to the same type or age as Cro-Magnon man. The primitive type of *Homo sapiens* was I believe evolved from a group that was akin to but not identical with *Homo neanderthalensis*.

Whatever the date of the Boskop remains may be the evidence now in our possession suggests that this early inhabitant of the Transvaal represents the type of the immediate ancestors of the men of the Upper Palæolithic Age, possibly somewhat modified in the course of his Southern Migration. It probably represents the earliest (not necessarily in actual age) known phase of *Homo sapiens* in the course of his transformation from a condition analogous to that of Neanderthal man to that of Cro-Magnon.

The specimens having now been returned to the Port Elizabeth Museum for over two years, and the Trustees having given me full permission to further investigate the remains, no apology need be offered for presenting the results of a renewed examination in view of the extreme importance of the type. As with the Piltdown skull, the type is annoyingly imperfect and is likely to give rise to as much discussion.

The Piltdown skull has a skull-cap which agrees so closely with that of even modern man that it is very doubtful if any one would have regarded it as belonging to a different genus or as being more than an early strictly human type had it not been for the fortunate discovery of the lower jaw which reveals certain distinctly pre-human characters. So in my opinion is it with the Boskop skull, where the lower jaw, imperfect though it is, reveals certain characters which make it necessary to place it in a distinct new species of *Homo*.

Mr. Haughton has described the imperfect mandible at some length and given a couple of illustrations of it. Only part of one tooth is preserved and this is quite manifestly the second molar. Mr. Haughton states: —

its crown is not complete, but so far as can be seen it shows no trace of a posterior denticle such as appears in several primitive types.

In my opinion, the crown is completely gone, and what appears to be crown is only the worn upper portions of the roots. The X-ray photograph seems to show this quite satisfactorily.

In the anterior part of the jaw, as preserved, are the imperfect remains of the sockets of three teeth. How the jaw must be restored depends on how those teeth are identified. About 24 mm. in front of the most anterior

part of the root of m^2 is a large oval socket which is being partly filled in by new bone formation. The larger diameter of the oval lies in line with the alveolar border. Whether this large socket has been formed by the root of a tooth or very largely by pyorrhoea is a point on which opinions will differ, but no doubt it is mainly due to the root of a tooth, and unfortunately, there is a difference of opinion as to which tooth it represents.

Haughton in describing the anterior part of the mandible says: —

> The alveolus for the 1st incisor is missing; that of the second incisor (represented by its inner portion) is small. That for the first premolar is enlarged into a roughly circular hole with a diameter of 9 mm.

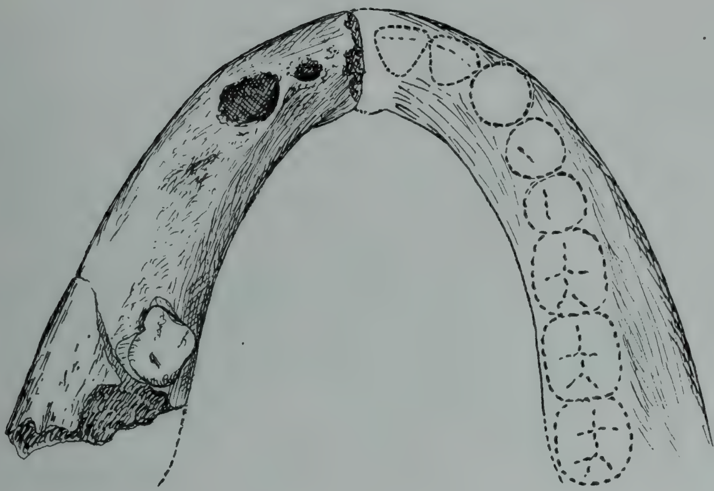
In my view the three sockets of which we have remains are those not of pm^1, c, and i^2, but c, i^2 and i^1. If we assume that the large socket is that of the first premolar we have a space of, at the very least, 24 mm. to be filled by pm^2 and m^1, and if we consider the socket to have been enlarged by pyorrhoea, a still larger space. Though the series of human skulls and of illustrations of jaws at hand is limited, I can find no case of a human jaw where pm^2 and m^1 occupy nearly 24 mm. Further, if the large socket is that of pm^1 the anterior part of the jaw must have had a contour unlike that of any known human type.

If, however, we regard the large socket as that of the canine we are able to restore the jaw not quite like a modern human jaw but as one which is not very far removed from the human form. In my opinion there is no reasonable doubt that the socket is that of the canine, and I am also of the opinion that the canine was appreciably larger than in the jaw of modern man. But whether the canine was enlarged or of the normal human size, the incisors must have been enlarged as the space occupied by the incisors must have been at least 28 mm.— possibly considerably more. If the canine were of the normal human size and occupied the center of the socket, then the space occupied by the incisors must have been over 30 mm.

Though with the loss of the teeth, much of the upper part of the jaw has been absorbed, what remains shows that the jaw must have been unusually massive. The restorations I give indicate the probable contours before loss of the teeth. In front of m^2 the thickness of the jaw is about 17 mm. and in the plane behind m^2 about 20 mm. making allowance for a slight displacement of the bone. In the region of m^3 the width must have been at least 21 mm.

In the figure given of the outer side of the jaw there are seen to be two foramina for the exit of the sensory nerve — a posterior small one below m^1 and a large anterior below pm^1.

Haughton has given a full description of the skull-cap with good figures



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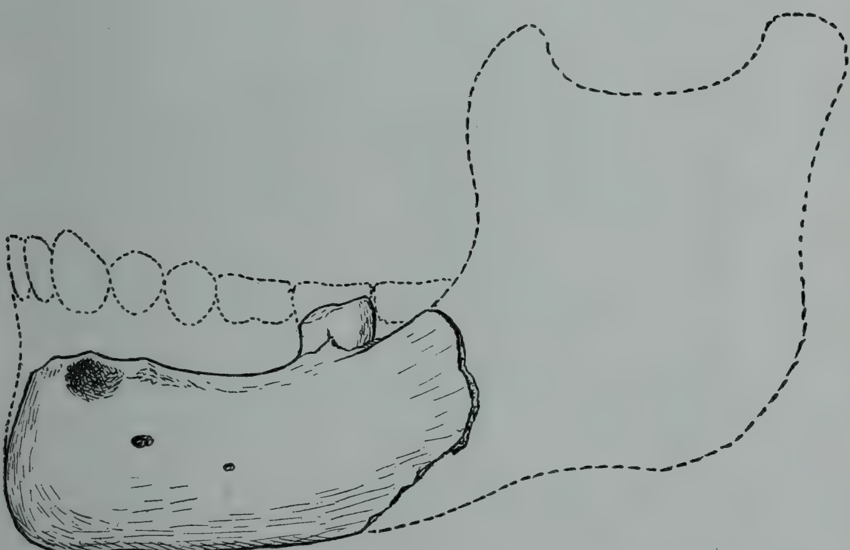
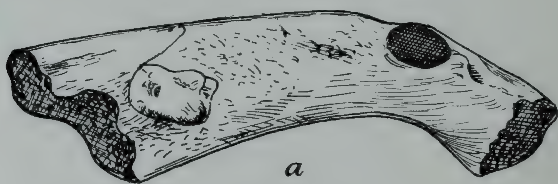


b

Fig. 3. *a*, Front Portion of Lower Jaw of *Homo capensis*. Nat. size. Upper view. The left ramus is represented as preserved; the right is restored with the teeth as they probably were before being worn and lost; *b*, Restoration of Lower Jaw of *Homo capensis*. Nat. size. The fragment known is shown in true side view and foreshortened.

and there is not much that need be added. My measurements of the skull were made before Haughton's description appeared and in a few minor points differ from his. He estimates the greatest length of the skull at about 205 mm.; I consider it to have been about 210 mm. The difference is due to my belief that there was a moderately developed ridge connecting the supraorbital ridges in the middle line. Haughton estimates the maximum breadth at about 154 mm.; I make it about 160 mm. On the right



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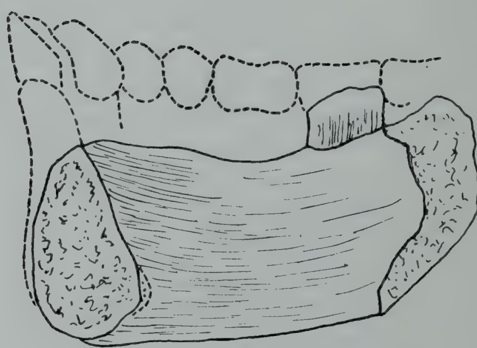

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Fig. 4. *a*, Another View of the Jaw Fragment of *Homo capensis*. Nat. size; *b*, Inner Side of Jaw of *Homo capensis*. Nat. size. Reversed for comparison with others.

side the widest part of the parietal is lost and on the left slightly crushed in, and the width has to be calculated either by completing the curve on the right side or correctly estimating the crushing on the left. The difference between our estimates is not great, but it makes an appreciable difference in the cephalic index. According to Haughton's estimates this is 75.1; according to mine, 76.19.

One of the most marked characters of the Boskop skull is the great thickness of the bone in parts. The parietals in the region of the bosses

are from 13 mm. to 15 mm. thick, but thin rapidly towards the temporal borders. The frontals in the thickest part are 12 mm. thick but comparatively thin 30 mm. above the small supraorbital ridges. The frontal sinuses are small and the supra-orbital ridges scarcely more developed than in modern Kaffirs.

Haughton gives for comparison with the contour of the skull-cap of the Boskop man similar outlines from the skulls of various races — the Cro-Magnon, Neanderthal, Bantu, Bushman, and Hottentot — and concludes that the general characters of the calvaria "agree closely with those of the Cro-Magnon type." The mode of comparison adopted by Haughton is, however, I think open to criticism, and it will be observed that even taking the outlines he gives, the curve of Spy II agrees much more nearly with that of the Boskop skull than it does with that of the Gibraltar skull, which is generally held to be like Spy II of Neanderthal type.

As the skull-cap is unusually long and also very broad, the brain cavity must also have been of altogether exceptional dimensions. Haughton states: —

> The cranial capacity must have been very large .... In order to obtain the basilo-bregmatic height I have placed the temporal bone in what I conceive to be the highest possible position and so obtain a height of 140 mm. Even supposing the height to be 10 mm. too great which must be the maximum error possible the calculation of the capacity by Broca's method gives the minimum figure as 1832 cc .... In this connection it must be noted that the skull wall is very thick and that the bi-stephanic width is small so that some reduction of this figure is necessary .... The brain capacity of the Boskop skull must have been at least as great as that of Cro-Magnon which is given as roughly 1660 ccs. and was probably somewhat greater.

Elliot Smith, not having seen the temporal bone or its cast, gives no estimate of the cranial capacity, though he speaks of its great size and the "remarkable figure" of the length.

The temporal bone is well preserved and nearly perfect. A small portion of the parietal is in contact with its posterior part, and part of the articulation for the alisphenoid is present. The squamous portion is all preserved, except the flat thin part, which overlaps the parietal. As we have preserved a part of the parietal with the articulation for the temporal quite complete in depth, we can be pretty certain of the position of the temporal as regards relative height to within 2 or 3 mm. and its position antero-posteriorly to within 10 mm. In the restoration I have given of the side view of the skull I do not think the error in the position of the upper part of the temporal can be more than 2 mm. in height or 5 mm. antero-posteriorly. With the temporal placed in this position the height of the bregma above the level of the mastoid is 148 mm. It might be made a little more, but it cannot

possibly be made less. I cannot understand how Haughton, after placing the temporal in what he conceives to be "its highest possible position" and getting a height of 140 mm., should, to calculate the cranial capacity, place it still 10 mm. higher. Had he made the calculation according to Broca's formula with the height as 140 mm. the result obtained would have been 1972 cc. which is probably very nearly the correct figure.

Haughton thinks Broca's formula will give too large a figure because of the thickness of the skull, but the skull is by no means uniformly thick. The frontals in front of the frontal lobes are in fact very thin and the occiput not unduly thick, as may be seen from the fact that the cranial cast has a measurement of 197 mm. greatest length, or only 8 mm. less than what Haughton gives for the maximum length of the calvaria. Further, though the parietals have extremely thick bosses these stand out and do not encroach much on the cranial cavity.

I have made a complete restoration of the cranial cast by placing the temporal in its true position and restoring the left side from the right, and an examination of the photograph of the cast will show how very little is left to the imagination. The temporal gives us the size and position of the temporal lobes, and the position of the lateral sinus, and considerable indication as to the position of the occiput. The cranial cast as thus restored displaces about 1960 cc. of water. If we add 20 cc. as correction for the slight crushing of the left side we get for the corrected cranial capacity of the Boskop skull the very remarkable figure of 1980 cc.

There is always a tendency to consider that any new and unexpected type of human skull must be abnormal or pathological. The Neanderthal skull was for long held to be pathological, and the Trinil skull has been regarded as that of a microcephalic idiot. But fortunately it is unlikely that any one will, after Elliot Smith's report on the brain cast, maintain that the large brain of the Boskop skull is pathological and there seems to remain but one conclusion, namely, that in South Africa in very early times there lived a race of primitive man characterized by having a large skull with very thick parietal bosses, a brain of great size and a powerful jaw with incisors and canines much larger than those in modern man. For this type of which we at present only know the one specimen, I propose the name *Homo capensis,* regarding it as sufficiently distinct from *Homo sapiens* to be worthy of specific rank.

The large size of the cranium naturally suggests affinity with the Cro-Magnon type, but there are many important differences, and while it may be ancestral to the Cro-Magnon race, it cannot in my opinion belong to that type. This is practically the conclusion suggested by Elliot Smith from the examination of the upper part of the brain cast alone. "It probably repre-

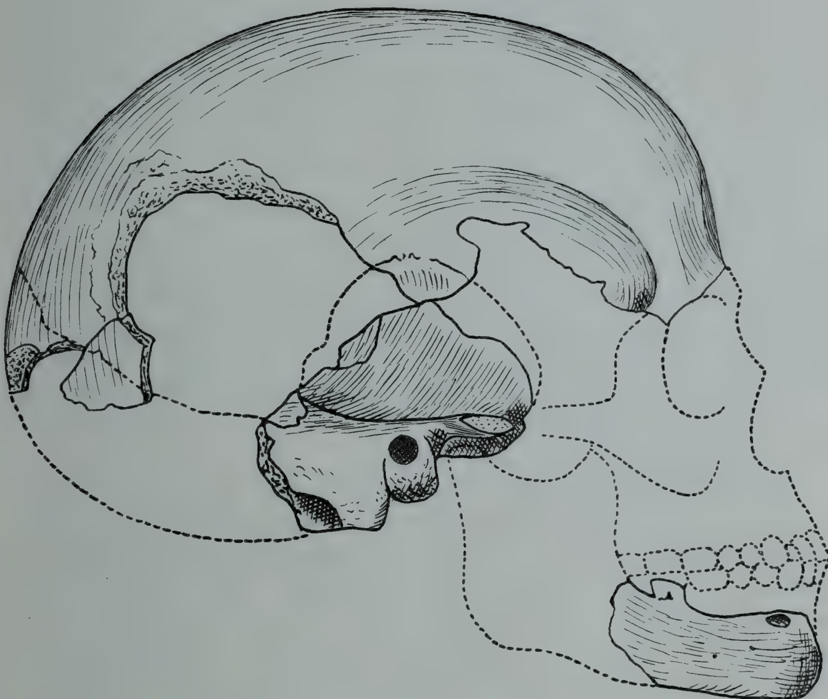

Fig. 5. Restoration of the Skull of *Homo capensis*. 46/100 Nat. size. The parts shaded are those known.

sents," he says, "the earliest known phase of *Homo sapiens* in the course of his transformation from a condition analogous to that of Neanderthal man to that of Cro-Magnon."

Apart from the great development of the supraorbital ridges and unusual development of the facial region, the resemblance of the Boskop type to the Neanderthal is about as great as to the Cro-Magnon.

By most anthropologists it is held that the Neanderthal type of man is a primitive, more simian, variety. But there is considerable reason for holding that the supposed simian characters are really only secondary, and Gorilla-like merely by convergence. Piltdown man with his Chimpanzee-like jaw[1] is certainly more simian than Neanderthal man, yet he lacks altogether the great supraorbital ridges. In fact, large thickened supraorbital regions are quite exceptional even among the apes. The Orang is not less simian than the Gorilla though its supraorbital ridges are feebly developed; and as the ridges in the Gorilla are manifestly not a primitive character, so probably not in Neanderthal man either. The remarkable facial development in the Neanderthal type has possibly resulted from some change in habit and dental function which has led to some alteration in the development of the pituitary region resulting in what may be called a physiological acromegaly. It is interesting to note that the only human race that has developed taurodontism is the one which has this remarkable development of the facial bones.

If the facial development of Neanderthal man is secondary such a type as *Homo capensis* might be ancestral to it as well as to Cro-Magnon man.

The relationship of the Boskop type to present South African races is a subject on which one cannot at present say much. South African anthropology, notwithstanding all recent work, is in very great confusion. The conclusions to which recent authorities have come are (1) that the Bushman is the earliest inhabitant of South Africa, (2) that the Strand-looper is the purest type of Bushman, (3) that the up-country Bushman is a mixture of Bushman and Hottentot, and (4) that the Hottentot is a cross between Bushman and a Negroid or Bantu race.

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[1] In view of the doubt that has been expressed as to whether the Piltdown jaw really belongs to the skull, it may be as well to state quite definitely the reasons why I side with Smith-Woodward, Elliot Smith, and Keith, as against Gerrit Miller, Osborn, and Gregory. Apart altogether from the great improbability, as Elliot Smith expresses it, of a large ape-like man and a large man-like ape dying at the same spot and at the same time, and one leaving his skull without the jaw and the other the jaw without the skull, I regard the jaw as essentially a human jaw. Even if large Chimpanzees had been very common in Northern Europe in Pleistocene times, I should still hold that this could not be a Chimpanzee jaw from the fact that the molar teeth are ground down by a transverse movement which it is physically impossible for any Chimpanzee to accomplish. There does not seem to me the slightest reason why we should hesitate in regarding the jaw as belonging to the same individual as the skull.

As regards the first conclusion, we have known for many years from non-Bushman implements that the Bushman was not the earliest inhabitant, and the discovery of the Boskop skull proves it beyond question. With regard to the second conclusion whether the Strand-looper is a pure race or not he cannot by any right be called Bushman as he is the typical Hottentot. The Strand-loopers around Table Bay had been called Hottentots for a hundred years before the Bushman was known. Whether the up-country so-called Hottentots such as Korannas are a hybrid race and a recent incursion, it is at present impossible to say, but I hope ere long to be able to throw some light on the subject.

From the study of implements we get some clues to early South African races. For example we have conclusive proof that probably ten or fifteen thousand years ago the banks of the Vaal River were inhabited by great numbers of a powerful race. This race was probably not Bushman. Still earlier — perhaps very much earlier — was another also powerful race — the race who made implements of the Stellenbosch type — and certainly not Bushman. This oldest race is possibly represented by the Boskop man. The second race I have some reason to suspect to be allied to the Koranna.

If the Boskop man were the maker of the Stellenbosch type of implements he may be looked upon as Man of the Chellean or Acheulean period.

80.

ANTHROPOLOGICAL PAPERS
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ANTHROPOMETRY OF THE SIOUAN TRIBES

BY

Louis R. Sullivan

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ANTHROPOMETRY OF THE SIOUAN TRIBES

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CONTENTS

ILLUSTRATIONS

Text Figures

TABLES

I. INTRODUCTION.

Acknowledgments.

The following material is the result of investigations made on the occasion of the World's Columbian Exposition, Chicago, 1893. The Department of Ethnology and Archaeology, with Professor F. W. Putnam as Chief, appointed Professor Franz Boas head of the sub-department of physical anthropology for the purpose of making an investigation of the physical characteristics of the various native peoples of the American continent. Investigations were carried on upon a majority of the larger tribal groups within the United States. This material, although not as yet fully reported on, constitutes the most comprehensive and important contribution to our knowledge of the physical characteristics of the North American Indian. Professor Boas has already reported in detail upon the Shoshonean[1] tribes and also upon stature,[2] cephalic index, and width of face for all the groups.

The present report deals only with the Siouan peoples. The observations were made by Messrs. F. C. Smith. J. W. Cooke, G. A. Kaven, Z. T. Daniels, Franz Boas, E. F. Wilson, C. A. Helvin, F. C. Kenyon, and G. M. West. The series of Kaven, Cooke, Smith, and Boas are the larger.

The records are still the property of Professor Boas to whom I am indebted for the privilege of working them up. This report is a part of the writer's laboratory work under Professor Franz Boas of Columbia University who has superintended the work and given advice as to method at various points. The writer alone is responsible for the accuracy of the calculations and feels a fair degree of confidence in them. I am also indebted to the Department of Anthropology of the American Museum of Natural History for valuable clerical help and for the time in which to carry on the work. Finally, I am indebted to my wife for very valuable assistance during the preparation of this report.

The Material.

The series includes 1431 individuals distributed as follows by age, sex, and blood:—

Male: Pure Sioux:	Children from 4 to 19 years	186	
	Adults from 20 to 59 years	540	
	Old individuals from 60 years on	54	
	Total Pure Sioux Male		780

[1]Boas, 1899.
[2]Boas, 1895, 1894-1, 1894-2.

Half-Blood:	Children from 4 to 19 years	97	
	Adults from 20–59	77	
	Total Half-Blood Male		174
Mixed-Blood Indians		7	
	Total Mixed-Blood Male		7
Female: Pure Sioux:	Children from 4 to 19 years	144	
	Adults from 20 to 59 years	157	
	Old individuals from 60 years on	24	
	Total Pure Sioux Female		325
Half-Blood:	Children from 4 to 19 years	123	
	Adults from 20 to 59 years	19	
	Total Half-Blood Female		142
Mixed-Blood Indians		3	
	Total Mixed-Blood Female		3
Total Series		1431	1431

The following bands or tribes representing subdivisions of the closely allied Siouan peoples are included among the full-blooded male adults:—

21 Santee	40 Oglala
13 Wahpeton	14 Waziahziah
54 Sisseton	11 Sans Arc
52 Yankton	30 Blackfoot
73 Yanktonai	13 Minneconjou
14 Cut Head	33 Two Kettle
1 Teton	36 Hunkpapa
66 Brulé	18 Assiniboin
12 Loafer	40 Miscellaneous

Total Series 541

About the same proportions hold for the remaining groups.

II. RESULTS.

Descriptive Characters.

Under descriptive characters are included such characters as pigmentation of the skin, hair, and eyes, form of the hair, form of the eyes, ears, nose, and lips. In the main, the value of such characters is not very great, due, not to any great extent to the fault of the observers but, to the use of unsatisfactory standards and the unavoidable range of personal estimation in evaluating minute differences in terms of relative magnitude.

Especially unsatisfactory are observations as to skin color. Special color charts were used. The colors occurring most frequently would correspond to numbers 14 to 24 inclusive of Von Luschan's Hautfarben-Tafel. The results for skin color on the palms of the hands, and exposed and unexposed parts of the body indicate that this test was not very sensitive. Nor is it possible to distinguish certain differences between full-bloods and half-bloods. This should not be taken to indicate that such differences do not exist, but simply that our tests were not sufficiently sensitive to color differences.

The hair color is almost uniformly recorded as black. One observer recorded 14 individuals among the 541 pure Sioux males with dark brown hair and 5 individuals with light brown hair. All the other observers recorded the entire series as having black hair. Among our 77 half-bloods, 11 were recorded with dark brown hair, one with blond, and all the others, black.

Of the full-bloods 25 are recorded as having wavy and 4 as having curly hair. The remaining 512 have straight hair. Of the 77 half-bloods 9 have wavy and 4 curly hair.

As to the development of the beard and moustache there seems to be a real difference between full-bloods and half-bloods. Very few of the full-bloods have any beard on the upper or lower cheek. About 15 percent of the full-bloods have a scanty beard on the chin and about 25 percent have a scanty moustache. Among half-bloods 20 percent have a scanty beard on the upper cheek, 35 percent have a scanty beard on the lower cheek, 65 percent have some development of a beard on the chin, and 80 percent have moustaches. However, many of the full-bloods and several of the half-bloods are reported as having pulled out the beard or moustache hair.

The eye colors of the males are as follows:—

	Full-bloods	Half-bloods
Black	185	14
Dark Brown	338	39
Light Brown	7	14
Gray	4	7
Blue	5	3
Total	539	77

It should be noticed that among the full-blooded Indians 4 are reported as having gray eyes and 5 with blue eyes. Very probably these are mixed-bloods, although the hair color and form, and facial width favor the full-bloods in these instances.

Diagrams of different types of eye form were also used, but the results are very unsatisfactory and not worth recording.

The nasal bridge is reported as high or medium throughout both groups. The profile of the nose is convex and slightly arched in a majority of instances. The nostrils are elongate with the long axes in an antero-posterior direction. Among the full-bloods the point of the nose is recorded as long and thick and among half-bloods as long and thin in a majority of cases.

The thickness of the lips and the slope of the upper lip varies with each observer and the results are not comparable.

The ears are rounding and stand close to the head in most individuals. The helix is thin and rolled inward in nearly every instance. In 5 individuals the helix (upper portion) is recorded as being rolled outward and in 11 flat. The antehelix is high and narrow.

While the majority of these descriptive characters are subject to a considerable personal error of observation, on the whole it seems perfectly justifiable to say that the half-blood approaches the Indian more closely than the white in skin color, hair color and form, and eye color. On the other hand, the half-bloods seem to approach the white in the development of beard and moustache hair.

Anthropometric Characters.

The measurements taken were as follows:—

1. Stature: without shoes.
2. Shoulder height (to acromion).
3. Arm length (shoulder height minus height to point of middle finger).
4. Arm reach: maximum span.
5. Height sitting.
6. Width of shoulders (bi-acromial width).
7. Head length (maximum).
8. Head width (maximum).
9. Face height:—
    (a) Hair line to chin.
    (b) Nasion to chin.
    (c) Nasion to mouth.
10. Width of face (maximum bizygomatic).
11. Height of nose (nasion to sub-nasal point).
12. Width of nose (maximum).

From these measurements the following indices were calculated:—

1. Arm length (arm length to stature).
2. Arm reach (arm reach to stature).
3. Height sitting (height sitting to stature).
4. Shoulder width (shoulder width to stature).
5. Cephalic (width to length of head).
6. Cephalo-facial (width of face to width of head).
7. Facial (anatomical) (height of face [9 b] to width of face).
8. Nasal (width to height of nose).

The averages of the series of each observer were obtained separately in order to determine in how far they agreed with each other. Unfortunately, no check measurements were made and it is impossible to determine the error of observation. A close study of the various averages indicates that the measurements of stature, arm reach, height sitting, head length, head width, face width, and nose width are the most reliable and show the smallest differences between the different series. Shoulder height, shoulder width, and arm length are not quite as satisfactory. The largest differences, which are undoubtedly due to differences in technique, are found in the three measurements of face height and nose height. Nevertheless, it has seemed best not to correct the measurements but to use them as they stand. The averages of each observer are listed for each measurement and the reader can judge for himself in how far the results are in agreement.

TABLE I.

PRINCIPAL MEASUREMENTS BY TRIBES AND BANDS.

PURE SIOUX MALE.

Tribe or Band *	No. of Cases	Stature			Cephalic Index			Length of Head			Width of Head			Width of Face		
		Aver.	σ	e	Aver.	σ	e	Aver.	σ	e	Aver.	σ	e	Aver.	σ	e
Santee	21	173.7	6.43	1.40	79.8	2.50	.54	194.1	5.76	1.25	155.1	5.83	1.27	147.2	5.58	1.22
Wahpeton	12	174.4	4.54	1.31	78.0	2.38	.68	196.2	5.35	1.54	152.6	3.66	1.05	148.4	5.40	1.62
Sisseton	54	173.0	6.26	.85	78.3	2.89	.39	195.1	6.26	.86	152.7	4.67	.63	147.2	5.48	.74
Yankton	52	172.4	5.26	.72	80.2	2.91	.40	194.8	5.78	.80	156.0	5.87	.82	150.8	6.60	.91
Yanktonai	72	171.2	6.09	.72	79.7	3.18	.37	193.7	5.91	.69	154.3	4.78	.56	148.6	5.03	.59
Cut Head	13	170.2	4.03	1.12	80.4	2.95	.79	192.1	5.22	1.39	154.4	5.18	1.38	148.4	4.41	1.18
Teton	1	178.0			86.0			190.0			163.0			143.0		
Brulé	66	173.3	4.75	.58	79.2	3.40	.42	194.1	5.06	.62	153.8	4.92	.60	148.8	4.25	.52
Loafer	11	173.5	4.46	1.34	78.7	2.52	.76	194.1	5.74	1.76	152.8	4.99	1.50	146.0	3.88	1.16
Oglala	39	172.8	4.91	.78	80.9	3.02	.47	193.3	5.71	.90	156.3	5.32	.84	150.0	5.01	.79
Waziahziah	14	173.6	4.81	1.29	80.6	2.13	.57	195.6	3.73	.99	157.4	3.98	1.06	150.8	4.14	1.10
Sans Arc	11	170.3	5.51	1.66	80.4	4.10	1.23	193.0	6.22	1.87	155.6	6.46	1.94	148.2	4.43	1.33
Blackfoot	30	171.7	5.65	1.03	79.7	4.48	.81	197.9	7.92	1.44	158.4	6.37	1.16	152.6	5.39	.96
Minneconjou	13	172.8	5.61	1.55	79.8	2.62	.72	193.4	4.97	1.37	154.7	3.91	1.09	149.3	4.61	1.28
Two Kettle	34	173.2	6.18	1.06	79.0	2.28	.39	196.2	6.10	1.04	155.4	5.23	.91	149.2	4.51	.77
Hunkpapa	36	172.0	5.70	.95	79.6	2.56	.43	197.5	5.22	.89	157.6	4.60	.76	153.6	4.32	.73
Assiniboin	18	168.1	5.50	1.29	79.0	3.85	.90	195.9	8.26	1.94	154.7	5.32	1.25	144.1	4.61	1.09
Sioux (Miscel.)	40	173.7	5.28	.83	80.7	3.45	.54	195.0	5.54	.87	156.8	5.57	.87	147.9	5.02	.79
Total Series	538	172.4	5.64	.24	79.6	3.20	.14	194.9	6.16	.26	155.1	5.39	.23	149.1	5.45	.23

*Lines include bands most closely related linguistically.

TABLE II.

RELATION OF DIFFERENCE BETWEEN AVERAGE FOR TOTAL SERIES AND AVERAGE OF TRIBAL GROUPS TO THE DEVIATION OF THE AVERAGE

	Stature		Cephalic Index		Length of Head		Breadth of Head		Breadth of Face	
	A_1-A_2	$\sqrt{e_1^2+e_2^2}$	A_1-A_2	$\sqrt{e_1^2+e_2^2}$	A_1-A_2	$\sqrt{e_1^2+e_2^2}$	A_1-A_2	$\sqrt{e_1^2+e_2^2}$	A_1-A_2	$\sqrt{e_1^2+e_2^2}$
Santee	1.30	1.42	.20	.56	.80	1.28	.0	1.29	1.90	1.24
Wahpeton	2.00	1.33	1.60	.69	1.30	1.56	2.50	1.07	.70	1.63
Sisseton	.60	.88	1.30*	.41	.20	.90	2.40*	.67	1.90	.77
Yankton	.00	.76	.60	.42	.10	.84	.90	.85	1.70	.94
Yanktonai	1.20	.76	.10	.40	1.20	.74	.80	.60	.50	.63
Cut Head	2.20	1.14	.80	.80	2.80	1.41	.70	1.40	.70	1.20
Teton										
Brulé	.90	.63	.40	.45	.80	.67	1.30	.64	.30	.56
Loafer	1.00	1.36	.90	.77	.80	1.78	2.30	1.52	3.10	1.18
Oglala	.40	.82	1.30	.49	1.60	.94	1.20	.87	.90	.82
Waziahziah	1.20	1.31	1.00	.58	.70	1.02	2.30	1.08	1.70	1.12
Sans Arc	2.10	1.68	.80	1.24	1.90	1.89	.50	1.95	.90	1.35
Blackfoot	.70	1.06	.10	.82	3.00	1.46	3.30	1.18	3.50*	.98
Minneconjou	.40	1.57	.20	.73	1.50	1.40	.40	1.11	.20	1.30
Two Kettle	.80	1.08	.60	.41	1.30	1.07	.30	.94	.10	.80
Hunkpapa	.40	.98	.00	.45	2.60	.93	2.50*	.79	4.50*	.76
Assiniboin	4.30*	1.31	.60	.91	1.00	1.96	.40	1.27	5.00*	1.11
Sioux (Miscel.)	1.30	.87	1.10	.56	.10	.91	1.70	.90	1.20	.82

* Denotes real mathematical difference.

Homogeneity of the Series.

It remains to justify the inclusion in a single series of the results of observations on the seventeen different local groups. Even if we subdivide our total series into the local groups the majority of these groups are of sufficient size to serve as an indication of the true state of affairs. In Table I, I have listed the average, variability, and error for stature, cephalic index, length of head, width of head, and width of face.

It will be seen that the results are in very close agreement. When we compare the average of any group for any measurement with the average for the total series the differences are very small. In Table II, I have compared the differences of the averages of the various groups (A_1-A_2) with the magnitude of the variability of the averages ($\sqrt{e_1^2+e_2^2}$). We find a real mathematical difference between the averages of a given measurement in only seven instances. Yet even these are border-line cases. One is found in stature (Assiniboin), one in the cephalic index (Sisseton), two in breadth of head (Sisseton and Hunkpapa) and three in width of face (Blackfoot, Hunkpapa, and Assiniboin). Of the five characters real differences in two occur in the Sisseton, Hunkpapa, and Assiniboin series. On the whole then, it would seem that the various local groups constitute a fairly homogeneous series.

Among anthropologists who seek to explain the diversity of the American Indian physically by proposing two migrations, the one of a short, short-headed type and the other of a tall, long-headed type, the Sioux are usually pointed to as the results of intermixture of these two types. This is due in part to the fact that they occupy an intermediate geographical position and in part to the fact that their head form is intermediate between the two extremes in proportion. At the present time practically no correlation exists between stature and the cephalic index among the Sioux. The average cephalic indices for different statures among the full-blooded male Sioux are as follows:—

Stature	Cases	Cephalic Index	Stature	Cases	Cephalic Index
152–155	(2)	79.0	172–175	(151)	79.9
156–159	(6)	79.5	176–179	(109)	79.7
160–163	(27)	80.5	180–183	(35)	78.8
164–167	(62)	80.2	184–187	(8)	78.8
168–171	(133)	79.5	188–190	(3)	79.0

No real differences exist. So then we have seen that subdivisions of the total series by observers, by local groups, and by stature have revealed only a very few scattered differences among the most dependable

measurements which might be regarded as real differences. Whatever the source of the elements which characterize the Sioux Indians they are today a reasonably homogeneous group; so much so, that if they represent the intermixture of two different types, it is impossible to point out the elements they received from one group or another. On the other hand, it is reasonable to believe that some of the individuals listed as full-bloods are breeds of varying degrees. But this number probably represents only a very small minority and is probably several generations removed from the time of the intermixture.

Stature.

Comparability of Results. As we have already seen, most of the observers measured different tribal bands and it is impossible to determine definitely the personal error of these different observers. However, on comparing the average stature of the various local groups we found that the only instance in which there was any certain difference was in the case of the Assiniboin. The averages of all other groups were very similar and indeed the Assiniboin were just within the limits of a possible difference. On the other hand, most of the observers measured individuals belonging to more than one local group. In Table III I have listed the averages of the series obtained by the different observers. There are no certain differences. On the whole we may assume that the results of the different observers are comparable.

TABLE III

Stature: Averages for Different Observers.

(Ages 20-59 inc.)

Observer	Male				Female			
	Pure Sioux		Half-blood		Pure Sioux		Half-blood	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	173.4	18	173.9	30	160.6	7	158.4
J. W. Cooke	174	171.7	14	172.9	33	159.9	2	161.5
G. A. Kaven	240	172.7	26	172.8	82	160.1	5	164.6
Z. T. Daniels	12	173.8	5	175.2	2	158.0	...	.....
F. Boas	34	173.4	8	174.5	3	152.7	2	164.0
C. A. Helvin and F. C. Kenyon	9	170.6	6	173.2	3	164.3	2	156.5
E. F. Wilson	18	168.5	...	.....	3	158.7	...	.....
G. M. West	...	.....	...	.....	1	162.0	1	167.0
Total Series	537	172.4	77	173.5	157	160.0	19	161.2

Sex. As usual the men are considerably taller than the women both among the full-blood and half-blood Indians. In the former the difference in the average of the two sexes is 12.4 cm., and in the latter the difference is 12.3 cm. The average for women among the full-bloods equals 92.8 percent of the male average and among the half-bloods 92.9 percent. This ratio between the averages of the two sexes is very similar to the ratio among other North American Indians of tall stature.

Blood. A study of the distribution in the various groups indicated in Table IV and Fig. 5 reveals some interesting results. Among the full-bloods, both male and female, we get some resemblance to a normal frequency curve but among the half-bloods the distribution is more irregular. There are so few female half-bloods that our comparison must, for the most part, be confined to the men. In both cases, however, the half-bloods are taller than the full-bloods. Although the difference is not mathematically a real difference, yet the consistency of the results for male and female adults and children for almost every year indicates beyond much doubt that in this particular instance at least the half-bloods are slightly taller than the full-bloods. Professor Boas[1] has previously pointed out this difference for this and several other series.

In some instances this difference might be interpreted to mean that the Indians had mixed with a group that was on the average taller than themselves. In this particular case such an explanation cannot be accepted. Our full-bloods are a very tall people. It is highly improbable that they have mixed with a group of people taller than they. In the majority of instances the half-bloods are the results of intermarriage with the French. In a few cases the other stock has been Scotch. The French most certainly are not taller than our Sioux Indians and the Scotch very doubtfully so. In certain parts of Scotland the average stature exceeds 172.4 cm., but a miscellaneous group of American-Scotch measured by Professor Boas[1] had an average stature of 172.1 cm.

The above results which are apparently not in keeping with our accepted laws of heredity are made still more difficult of interpretation when the results of Wissler[2] are consulted. In dealing with a series of 1770 male and 1193 female of the Oglala subdivision of the Teton-Dakota, Wissler finds the half-bloods slightly shorter than the full-bloods and apparently falling in line with accepted laws of heredity. However, the average stature for all his groups is higher than that ob-

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[1]Boas, 1895.
[2]Boas, 1911.
[3]Wissler, 1911.

TABLE IV.
STATURE: DISTRIBUTION.
(Ages 20–59).

	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
Cm.	No.	Percent	No.	Percent	No.	Percent	No.	Percent
146					1	.6		
148					4	2.5		
150					4	2.5		
152	1	.2			8	5.1	1	5.3
154	1	.2	2	2.6	14	8.9	2	10.6
156	3	.6	0	.0	15	9.5	3	15.8
158	3	.6	0	.0	20	12.7	3	15.8
160	7	1.3	0	.0	29	18.4	2	10.6
162	20	3.7	4	5.2	24	15.2	1	5.3
164	24	4.5	7	9.1	13	8.3	2	10.6
166	38	7.1	2	2.6	12	7.6	2	10.6
168	47	8.8	4	5.2	8	5.1	1	5.3
170	85	15.8	5	6.5	2	1.3	0	.0
172	86	16.1	11	14.3	2	1.3	2	10.6
174	65	12.1	11	14.3	1	.6		
176	49	9.1	8	10.4				
178	60	11.2	10	13.0				
180	22	4.1	8	10.4				
182	15	2.8	2	2.6				
184	6	1.1	1	1.3				
186	2	.4	1	1.3				
188	2	.4	0	.0				
190	1	.2	0	.0				
192			0	.0				
194			1	1.3				
Average	172.4		173.5		160.0		161.2	
σ	±5.64		±6.81		±5.29		±5.79	
e	± .243		± .77		± .42		±1.33	
V in %	3.27		3.92		3.30		3.59	
No. of cases	537		77		157		19	

Mixed Indian

Average 7 men 172.2 3 women 159.6

σ = standard deviation
e = error of average
V = coefficient of variation in percentage

tained in the present series. The average stature of Wissler's half-bloods is much nearer the average stature of full-blooded Sioux than to that of the whites with whom they have mixed. No satisfactory solution of these contradictory results can be given so long as our series are incomplete in lacking the measurements on the whites with whom the Indians have mixed.

Returning to our own series we notice also that the half-bloods are absolutely and relatively more variable than our full-bloods. Our full-bloods, however, are rather variable in stature. The variability is somewhat higher than that of many uncivilized peoples and more comparable with the variability of some of our European nations. Yet it is lower than the variability of most of the European groups represented among our immigrants.[1]

Age and Growth. As a whole there are too few individuals for each year to throw any light on the exact rate of growth. In general the rate of growth in stature is similar to that described for other racial groups. However, the excess in height among half-blood males is most noticeable after the fifteenth year which would indicate a prolongation of the period of rapid growth. Among the full-bloods the girls are slightly taller during the tenth, eleventh, and fourteenth year and among half-bloods during the thirteenth and fourteenth year. Among the males the half-bloods are taller for nine ages, the full-bloods for five, and the two are equal in three instances. Among the females the half-bloods are taller for eight years, the full-bloods taller for eight years, and the two equal in one instance. Individuals above 60 show a considerable decrease in stature.

Height of Shoulder.

(Acromial Height)

Comparability of Results. The average for the series of each observer is listed in Table VI. Where the number of individuals measured was sufficiently large the results are not very different for different observers.

Sex. The sex difference for full-bloods is 10.2 cm., and for half-bloods 9.1 cm. Although there is a considerable absolute difference in shoulder height the women have higher shoulders in proportion to their stature.

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[1]Boas, 1911.

TABLE V.

Stature: Growth.

Age	Male										Female									
	Pure Sioux					Half-blood					Pure Sioux					Half-blood				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	103.0									1	96.0								
5						1	116.0				2	99.0	3.0			1	111.0			
6	3	112.0	9.0	1.63	.94	4	114.8	−1.2			4	120 5	21.5			2	113.5	2.5		
7	6	118.8	6.8	4.68	1.90	5	125.0	10.2			5	122.8	2.3			8	119.4	5.9		
8	4	127.8	9.0	1.65	.82	2	127.0	2.0			7	121.1	−1.7			11	126.0	6.6		
9	13	131.6	3.8	3.85	1.07	3	131.0	4.0			4	128.5	7.4			7	130.8	4.8		
10	13	132.7	1.1	4.46	1.24	12	136.3	5.3			10	134.2	5.7	5.10	1.61	11	129.8	−1.0		
11	13	139.3	6.6	4.82	1.34	11	138.0	1.7			2	141.0	6.8			4	137.0	7.2		
12	11	147.0	7.7	4.59	1.38	7	145.7	7.7			14	143.6	2.6	3.41	.91	8	141.4	4.4	6.63	2.34
13	15	151.1	4.1	8.19	2.08	8	149.0	3.3			12	149.7	6.1	4.46	1.29	10	151.1	9.7	3.62	1.14
14	14	153.5	2.4	4.58	1.22	10	153.9	4.9			19	154.9	5.2	6.81	1.33	8	153.5	2.4	4.42	1.56
15	15	161.0	8.5	3.35	.86	5	160.8	6.9			8	156.9	2.0	4.86	1.72	10	156.7	3.2	4.40	1.39
16	18	164.8	3.8	6.68	1.57	10	166.2	5.4			10	158.6	1.7	2.69	.85	13	156.5	−.2	5.76	1.59
17	19	166.7	1.9	3.82	.87	6	168.8	2.6			18	160.2	1.6	4.03	.95	15	160.7	4.2	3.00	.79
18	20	168.3	1.6	4.54	1.01	4	169.8	1.0			12	157.6	−2.6	3.97	1.15	12	158.2	−2.5	5.58	1.61
19	21	173.1	4.8	4.71	1.03	9	171.3	1.5			16	159.9	2.3	4.41	1.10	3	160.0	1.8		
20–59	537	172.4	−.7	5.64	.24	77	173.5	2.2	6.81	.77	157	160.0	.1	5.29	.42	19	161.2	1.2	5.79	1.33
60+	54	170.4	−2.0	6.06	.82						24	157.7	−2.3	4.56	.93					

TABLE VI

HEIGHT OF SHOULDER: AVERAGES FOR DIFFERENT OBSERVERS.

Observer	Male				Female			
	Pure Sioux		Half-blood		Pure Sioux		Half-blood	
	No.	Aver.	No.	Aver.	No.	Aver.	No.	Aver.
F. C. Smith	51	143.4	18	142.1	30	132.4	7	131.0
J. W. Cooke	173	142.9	14	143.2	33	133.2	2	133.0
G. A. Kaven	237	142.8	26	141.3	82	132.3	5	135.6
Z. T. Daniels	12	144.3	5	145.8	2	132.5		
F. Boas	34	142.0	8	142.9		131.7	2	136.5
C. A. Helvin and F. C. Kenyon	9	139.5	6	141.5	3	136.3	2	128.5
E. F. Wilson	18	140.8			3	126.7		
G. M. West					1	134.0	1	139.0
Total Series	534	142.7	77	142.3	157	132.5	19	133.2

Blood. The distribution of shoulder height in Table VII and Fig. 5 resembles very closely the distribution of stature in the various groups. Among the half-bloods the curve is lower and more irregular than among full-bloods. The half-bloods are also much more variable in this character. Even though the half-bloods are taller the shoulder height of the full-bloods is absolutely and relatively higher. But the difference is not very great.

Age and Growth. The table (Table VIII) and curve (Fig. 4) of growth for shoulder height is very similar to that for stature. The shoulder height of full-bloods is consistently greater than that of half-bloods. The sex differences are most conspicuous after the fifteenth year. In individuals above 60 the shoulder height is considerably lower.

WIDTH OF SHOULDER.

(Biacromial Width).

Comparability of Results. The averages of the series of different observers in Table IX show a fair degree of agreement.

Sex. The sexual difference is 3.3 cm. for full-bloods and 3.5 cm., for half-bloods. The half-blood women have narrower shoulders than the full-blood women.

TABLE VII.
HEIGHT OF SHOULDER: DISTRIBUTION.

Cm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
120					2	1.3		
2					2	1.3		
4	2	.4			9	5.7	1	5.3
6	1	.2	2	2.6	12	7.6	3	15.8
8	2	.4	0	.0	20	12.7	0	.0
130	3	.6	0	.0	18	11.4	3	15.8
2	11	2.1	2	2.6	22	14.0	3	15.8
4	20	3.8	6	7.8	26	16.6	3	15.8
6	40	7.5	8	10.4	19	12.0	0	.0
8	46	8.6	7	9.1	19	12.0	4	21.0
140	88	16.8	8	10.4	5	3.2	1	5.3
2	82	15.4	9	11.7	1	.6	1	5.3
4	79	14.8	13	16.9	1	.6		
6	63	11.8	6	7.8	0	.0		
8	53	9.9	8	10.4	0	.0		
150	21	3.9	4	5.2	1	.6		
2	11	2.1	3	3.9				
4	8	1.5	0	.0				
6	1	.2	0	.0				
8	2	.4	0	.0				
160	0	.0	1	1.3				
2	1	.2						
Average	142.7		142.3		132.5		133.2	
σ	±5.03		±6.07		±4.89		±5.23	
e	± .21		± .69		± .39		±1.19	
V in %	3.52		4.26		3.69		3.92	
No. of cases	534		77		157		19	

Mixed Indian

Average 7 men	143.3	3 women	132.0

Blood. Neither the distribution of this character in Table X and Fig. 1 nor the averages show any marked differences between full-bloods and half-bloods. The range of variation is small.

TABLE VIII.

HEIGHT OF SHOULDER: GROWTH.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	78.0									1	75.0								
5						1	91.0				2	88.0	13.0			1	86.0			
6	2	87.3	9.3	2.48	1.43	4	91.0	.0			4	97.8	-9.8			2	90.5	4 5		
7	6	93.5	6.2	4.89	1.99	5	99.6	8.6			5	96.6	-1.2			8	94.8	4.3		
8	4	102.5	9.0	1.50	.75	2	100.5	.9			7	97.7	1.1			11	100.9	6.1		
9	13	106.0	3.5	3.82	1.06	4	107.0	6.5			4	103.5	5.8			6	105.5	4.6		
10	13	106.4	.4	4.98	1.38	12	109.8	2.8			10	108.5	5.0	4.43	1.40	11	105.0	– .5		
11	13	112.5	6.1	4.60	1.27	11	112.1	2.3			2	116.0	7.5			4	111.5	6.5		
12	11	120.7	8.2	3.76	1.13	7	118.7	6.6			14	117.1	1.1	4.17	1.11	8	115.4	– .1	5.43	1.91
13	15	124.1	3.4	9.75	2.51	8	122.2	3.5			12	122.8	5.7	4.10	1.18	10	123.9	8.5	3.64	1.15
14	14	126.3	2.2	3.47	.92	10	125.4	3.2			19	126.7	3.9	5.72	1.31	8	125.8	1.9	3.23	1.14
15	15	132.4	6.1	3.57	.92	5	130.4	5.0			8	129.4	2.7	4.24	1.50	10	129.0	3.2	4.84	1.52
16	18	135.7	3.3	5.54	1.30	10	135.9	5.5			10	130.5	1.1	2.25	.71	13	128.7	-1.3	5.13	1.56
17	19	136.7	1.0	3.42	.78	6	137.7	1.8			18	132.6	2.1	3.71	.87	15	132.4	3.7	2.96	.76
18	20	138.4	1.7	4.02	.89	4	138.8	1.1			11	130.9	-1.7	4.29	1.29	12	130.8	1.6	4.76	1.37
19	21	142.3	3.9	4.11	.89	9	139.4	.6			16	131.8	.9	3.74	.98	3	132.0	1.2		
20+	534	142.7	.4	5.03	.21	77	1 42.3	2.9	6.07	.69	1 57	132.5	.7	4.89	.39	-19	133.2	1.2	5.23	1.19
60+	54	142.0	-.7	5.71	.77						24	131.0	-1.5	3.44	.73					

TABLE IX.

WIDTH OF SHOULDER: AVERAGES FOR DIFFERENT OBSERVERS.

Observers	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	39.4	18	39.3	30	36.1	7	36.6
J. W. Cooke	173	38.4	13	38.0	33	35.8	2	37.0
G. A. Kaven	241	38.9	26	38.8	82	35.9	5	33.8
Z. T. Daniels	12	40.5	5	38.6	2	37.0		
F. Boas	34	39.9	8	40.1	3	35.0	2	34.5
C. A. Helvin and F. C. Kenyon	9	37.4	6	38.3	3	35.3	2	33.5
E. F. Wilson	18	36.3			3	32.7		
G. M. West					1	36.0	1	36.5
Total Series	538	38.8	76	38.9	157	35.5	19	35.4

TABLE X.

WIDTH OF SHOULDER: DISTRIBUTION.

Cm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
30	1	.2			5	3.2	1	5.3
2	5	.9	1	1.3	13	8.3	2	10.6
4	18	3.3	3	3.9	43	27.4	7	36.8
6	104	19.4	8	10.4	60	38.2	5	26.4
8	194	36.0	32	42.0	30	19.2	3	15.8
40	174	32.5	27	35.5	6	3.8	1	5.3
2	40	7.5	5	6.5				
4	2	.4						
Average	38.8		38.9		35.5		35.4	
σ	±1.92		±1.89		±2.09		±2.21	
e	± .08		± .22		± .17		± .51	
V in %	4.94		4.83		5.91		6.24	
No. of cases	538		76		157		19	

Mixed Indian

Average	7 men	37.3	3 women	36.3

TABLE XI.

Width of Shoulder: Growth.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	23.0									1	22.0								
5						1	25.0				2	23.5	1.5			1	24.0			
6	3	25.0	2.0			4	25.8	.8			4	25.5	2.0			2	25.5	1.5		
7	6	26.3	1.3	2.22	.90	5	28.0	2.2			5	26.6	1.1			8	26.0	.5		
8	4	29.2	2.9			2	27.0	−1.0			7	27.1	.5			11	27.4	1.4		
9	13	29.2	.0	1.31	.36	4	28.8	1.8			4	28.0	.9			6	28.8	1.4		
10	13	29.0	−.2	1.59	.44	12	29.7	.9			10	29.2	1.2	1.72	.54	11	28.6	−.2		
11	13	30.2	1.2	1.62	.45	10	29.7	.0			2	28.0	−1.2			4	28.5	−.1		
12	11	32.1	1.9	2.02	.61	7	31.0	1.3			14	31.0	−3.0	1.25	.33	8	30.4	1.9	1.40	.49
13	15	32.5	.4	2.07	.53	8	31.2	.2			11	32.1	1.1	1.62	.48	10	31.7	1.3	1.19	.37
14	14	33.6	1.1	1.55	.41	10	32.6	1.4			19	33.2	1.1	2.36	.54	8	32.1	.4	2.76	.97
15	15	35.2	1.6	1.68	.43	5	34.8	1.2			7	35.1	1.9	1.64	.62	10	33.4	1.3	.80	.25
16	17	35.9	.7	1.58	.38	10	36.3	1.5			10	35.0	−.1	1.41	.44	13	33.4	.0	1.94	.53
17	19	37.0	1.1	1.41	.32	6	37.3	1.0			18	34.6	−.4	1.96	.46	15	34.0	.6	1.93	.96
18	20	37.6	.6	1.36	.30	4	37.2	−.1			12	34.3	−.3	1.38	.37	12	33.8	−.2	1.49	.42
19	21	38.2	.6	2.09	.43	9	38.1	.9			16	34.7	.4	2.14	.53	3	34.3	.5		
20+	538	38.8	.6	1.92	.08	76	38.9	.8	1.89	.22	157	35.5	.8	2.09	.17	19	35.4	1.1	2.21	.51
60+	55	37.5	−1.3	1.99	.27						24	33.9	−1.6	2.09	.43					

Age and Growth. The curves of growth (Fig. 4) show greater differences between full-bloods and half-bloods, the full-bloods having consistently wider shoulders. There is a considerable decrease in shoulder width among individuals 60 years old and over.

Index of Shoulder Width.

Comparability. The average for the series of different observers in Table XII shows close agreement.

TABLE XII.

Index of Shoulder Width: Averages for Different Observers.

Observers	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	22.6	18	22.6	30	22.6	7	23.0
J. W. Cooke	171	22.4	14	21.9	33	22.2	2	22.5
G. A. Kaven	239	22.6	26	22.4	82	22.4	5	20.6
Z. T. Daniels	12	23.3	5	22.3	2	23.3		
F. Boas	34	23.1	8	23.1	3	22.3	2	21.0
C. A. Helvin and F. C. Kenyon	9	22.1	6	22.3	3	21.0	2	21.5
E. F. Wilson	18	21.6			3	21.7		
G. M. West					1	22.3	1	23.0
Total Series	534	22.5	77	22.4	157	22.4	19	21.9

Sex. The sex differences in relative width of shoulder are not pronounced except among half-bloods and here there are too few females to permit any definite conclusion.

Blood. As in the case of absolute shoulder width the distribution of relative shoulder width does not show any very great differences among the different groups. The curves in Fig. 7 are very similar. There are fewer extreme variants among the half-blood males and the variability is smaller than among the full-blood males. As a whole the series shows intermediate shoulder width. The average approaches very closely the average relative shoulder width of the American Indians and mankind as a whole.

TABLE XIII.

Index of Shoulder Width: Distribution.

Age.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
17	1	.2						
18	0	.0						
19	2	.4	1	1.3			1	5.3
20	22	4.1	3	3.9	12	7.6	2	10.6
21	51	9.6	6	7.8	20	12.8	3	16.8
22	191	35.5	29	37.6	52	33.2	6	31.6
23	167	31.2	29	37.6	45	28.6	5	26.4
24	95	17.8	9	11.7	24	15.2	2	10.6
25	4	.7			3	1.9		
26	1	.2			1	.6		
Average	22.5		22.4		22.4		21 9	
σ	±1.10		±1.01		±1.20		±1.35	
e	± .05		± .12		± .10		± .31	
V in %	4.88		4.51		5.36		6.16	
No. of cases	534		77		157		19	

Mixed Indian

Average for 7 men	22.2	3 women	22.7

Age and Growth. The curves of growth (Fig. 3) bring out more clearly that the full-bloods have relatively wider shoulders than the half-bloods. The curves for all four groups indicate very clearly that the shoulders are relatively considerably narrower during the period of adolescence than in early childhood or later in life.

Height Sitting.

Comparability of Results. The averages of the series of the different observers are listed in Table XV. No very marked differences occur in the larger series.

Sex. There is a sexual difference of 6.4 cm. for full-blood and 6.6 cm. for half-blood Indians. The females in both instances are more variable in this character.

Blood. The half-bloods consistently have a higher average sitting height although the difference is very small. The distribution is more regular and less variable among full-bloods than among half-bloods.

TABLE XIV.

INDEX OF WIDTH OF SHOULDER: GROWTH.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	22.0									1	23.0								
5						1	22.0				2	21.0	−2.0			1	22.0			
6	3	22.7				4	22.5	.5			4	21.1	.1			2	22.5	.5		
7	6	22.3	−.4			5	22.6	.1			4	21.8	.7			8	22.0	−.5		
8	4	22.8	.5			2	21.5	−1.1			7	22.4	.6			11	21.8	−.2		
9	13	22.1	−.7	.83	.23	3	22.0	.5			4	22.0	−.4			6	21.8	.0		
10	13	22.1	.0	.73	.20	12	22.0	.0			10	21.8	−.2	.75	.24	11	22.1	1.3		
11	13	21.6	−.5	.62	.17	10	21.4	−.6			2	19.5	−1.3			4	21.2	−.9		
12	11	21.9	.3	1.17	.35	7	21.6	.2			14	21.6	2.1	.69	.18	8	21.7	.5	1.33	.47
13	15	21.7	−.2	.80	.20	8	21.5	−.1			11	21.5	−.1	1.10	.33	10	20.9	−.8	.83	.26
14	14	22.0	.3	.88	.24	10	21.3	−.2			18	21.0	−.5	.85	.20	8	21.0	.1	1.66	.58
15	15	22.1	.1	.81	.23	5	21.8	.5			7	22.6	1.6	.74	.28	10	21.5	.5	.50	.16
16	17	21.9	−.2	.68	.16	10	22.0	.2			10	22.0	−.6	1.00	.31	13	21.5	.0	1.06	.29
17	19	22.3	.4	1.06	.24	6	22.0	.0			18	21.6	−.4	1.36	.32	15	21.2	−.3	1.66	.30
18	20	22.6	.3	1.07	.23	4	22.0	.0			12	21.8	.2	1.02	.29	12	21.5	.3	1.19	.24
19	21	22.2	−.4	1.18	.25	9	23.2	1.2			16	21.6	−.2	1.31	.33	3	21.6	.1		
20+	534	22.5	.3	1.10	.05	77	22.4	−.8	1.01	.12	157	22.4	.8	1.20	.10	19	21.9	.3	1.35	.31
60+	54	22.0	−.5	1.11	.17						24	21.6	.8	1.35	.27					

TABLE XV.

HEIGHT SITTING: AVERAGES FOR DIFFERENT OBSERVERS.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	89.3	18	90.5	30	82.5	7	82.2
J. W. Cooke	174	89.1	14	88.9	32	83.2	2	75.5
G. A. Kaven	240	87.7	26	88.6	82	81.0	5	84.2
Z T. Daniels	12	90.0	5	90.4	2	84.0		
F. Boas	34	90.1	81	90.9	3	87.6	2	87.0
. A. Helvin and F. C. Kenyon	9	88.9	6	90.0	3	88.0	2	82.5
E. F. Wilson	18	87.0			3	79.4		
G. M. West					1	86.0	1	91.0
Total Series	538	88.5	77	89.6	156	82.1	19	83.0

TABLE XVI.

HEIGHT SITTING: DISTRIBUTION.

Cm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
66							1	5.3
8			1	1.3			0	.0
70	1	.2	0	.0	1	.6	0	.0
2	0	.0	0	.0	0	.0	0	.0
4	0	.0	0	.0	2	1.3	0	.0
6	1	.2	0	.0	11	7.0	0	.0
8	0	.0	1	1.3	23	14.7	1	5.3
80	8	1.5	1	1.3	30	19.2	2	10.6
2	32	6.0	2	2.6	35	22.5	6	31.5
4	70	13.0	6	7.8	29	18.6	5	26.4
6	85	15.8	9	11.7	16	10.2	2	10.6
8	107	20.0	11	14.3	7	4.5	0	.0
90	117	21.8	20	26.0	1	.6	2	10.6
2	85	15.8	11	14.3	0	.0		
4	24	4.5	14	18.2	1	.6		
6	7	1.3	1	1.3				
8	1	.2						
100								

HEIGHT SITTING: DISTRIBUTION (*Contd.*)

Average	88.5	89.6	82.1	83.0
σ	±3.50	±4.39	±3.49	±4.91
e	± .15	± .50	± .28	±1.12
V in %	3.95	4.89	4.25	5.91
No. of casse	538	77	156	19

Mixed Indian

Average 7 men	89.0	3 women	84.4

Age and Growth. The half-bloods consistently have a higher average sitting height than the full-bloods. The females exceed from the twelfth to the sixteenth year. This measurement also decreases considerably in adults over 60 years of age.

INDEX OF HEIGHT SITTING.

Comparability of Results. There is a considerable degree of uniformity in the averages of the series of different observers listed in Table XVI.

Sex. The females have relatively a slightly higher index of sitting height. As in the absolute sitting height the females are more variable than the males for this character.

TABLE XVIII.

INDEX OF HEIGHT SITTING: AVERAGES FOR DIFFERENT OBSERVERS.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-blood s	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	51.5	18	52.0	30	51.8	7	51.9
J. W. Cooke	173	51.9	14	51.4	32	51.1	2	47.0
G. A. Kaven	239	50.8	26	51.2	82	50.7	5	51.2
Z. T. Daniel	12	51.8	5	51.6	2	53.0		
F. Boas	34	52.0	8	52.0	3	55.3	2	52.5
C. A. Helvin and F. C. Kenyon	9	52.2	6	52.5	3	53.3	2	52.5
E. F. Wilson	18	51.6			3	52.0		
G. M. West					1	53.0	1	54.0
Total Series	536	51.4	77	51.6	156	51.4	19	51.4

TABLE XVII.

HEIGHT SITTING: GROWTH.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	58.0									1	54.0								
5						1	61.0				2	62.1	.81			1	61.0			
6	3	60.3	2.3			4	61.8	.8			4	64.8	2.7			2	62.0	1.0		
7	6	63.5	3.2			5	66.6	4.8			5	65.0	.2			8	64.5	2.5		
8	4	69.0	5.5			2	67.0	.4			7	65.1	.1			10	67.1	2.6		
9	13	68.1	-.9	5.52	1.53	4	69.5	2.5			4	67.5	2.4			6	69.3	2.2		
10	13	69.2	1.1	2.52	.69	12	70.8	1.3			10	70.3	2.8	2.85	.90	11	68.3	-1.0		
11	13	72.5	3.3	3.22	.89	11	72.7	1.9			2	70.0	-.3			4	71.5	3.2		
12	11	75.9	3.4	2.71	.81	7	76.3	3.6			14	75.1	5.1	2.72	.73	8	74.0	2.5	3.00	1.06
13	15	77.3	1.4	3.83	.98	8	77.0	.7			12	77.6	2.5	3.50	1.01	10	79.1	5.1	2.38	.75
14	14	78.8	1.5	2.73	.73	10	79.9	2.9			19	80 4	2.8	3.29	.75	8	79.6	.5	2.44	.86
15	15	82.3	3.5	2.35	.61	5	80.4	.5			8	81.6	1.2	2.96	1.05	10	82.8	3.2	2.48	.78
16	18	83.0	.7	4.04	.95	10	84.4	4.0			10	84.2	2.6	1.83	.58	13	82.2	-.6	2.70	.74
17	19	85.5	2.5	2.32	.53	6	88.0	3.6			18	82.4	-1.8	1.86	.44	15	84.1	1.9	1.78	.46
18	20	86.8	1.3	2.32	.52	4	86.2	-1.8			12	83.0	.6	2.48	.72	12	83.9	-.2	3.72	1.07
19	21	89.9	3.1	3.14	.68	9	90.2	4.0			16	82.3	-.7	3.67	.92	3	85.3	1.4		
20+	538	88.5	-1.4	3.50	.15	77	89.6	-.6	43.9	.50	156	82.1	-.2	3.49	.28	19	83.0	-2.3	4.91	1.12
60+	54	85.5	-3.0	4 36	.59						24	78.7	-3.4	3.68	.75					

TABLE XIX.

INDEX OF HEIGHT SITTING: DISTRIBUTION.

Cm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
41			1	1.3			1	5.3
2			0	.0			0	.0
3			0	.0	1	.6	0	.0
4			0	.0	0	.0	0	.0
5			0	.0	0	.0	0	.0
6	1	.2	0	.0	1	.6	0	.0
7	5	.9	0	.0	1	.6	0	.0
8	22	4.1	2	2.6	7	4.5	0	.0
9	36	6.7	4	5.2	7	4.5	1	5.3
50	102	19.0	5	6.5	29	18.6	1	5.3
1	93	17.4	20	26.0	34	21.8	4	21.0
2	148	27.5	24	31.2	40	25.5	5	26.4
3	77	14.4	13	16.9	25	16.0	5	26.4
4	36	6.7	5	6.5	5	3.2	2	10.6
5	15	2.8	2	2.6	2	1.3		
6	1	.2	1	1.3	2	1.3		
7					1	.6		
8					0	.0		
9					1	.6		
Average	51.4		51.6		51.4		51.4	
σ	±1.68		±1.94		±1.90		±2.75	
e	± .07		± .22		± .15		± .63	
V in %	3.26		3.76		3.71		5.35	
No. of cases	536		77		156		19	

Mixed Indian

Average 7 men 51.6 3 women 51.4

Blood. The half-bloods apparently have a slightly higher index of sitting height. The distribution curves (Fig. 7) are regular except for the fact that the half-bloods, both male and female, present a few extreme cases which greatly increase their variability.

Age and Growth. As in the case of the index of shoulder width the curves of growth (Fig. 3) for the index of sitting height would seem to indicate that there is a rapid decrease in the proportionate height of the head and trunk during the adolescent period but that later in life

TABLE XX.

Index of Height Sitting: Growth.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	46.0									1	57.0								
5						1	53.0				2	57.0	.0			1	55.0			
6	3	54.0	8.0			4	53.8	.8			4	54.0	-3.0			2	55.0	.0		
7	6	53.7	-.3			5	53.2	-.6			4	50.8	-3.2			8	53.8	-1.2		
8	4	54.2	.5			2	53.0	-.2			7	52.3	1.5			10	53.2	-.6		
9	13	52.0	-2.2	1.57	.43	3	52.0	-1.0			4	52.5	.2			6	53.0	-.2		
10	13	52.3	.3	1.07	.30	12	51.8	-.2			10	52.2	-.3	1.18	.37	11	52.5	-.5		
11	13	52.2	-.1	1.19	.33	11	52.6	.8			2	49.5	-2.7			4	53.2	.7		
12	11	51.7	-.5	.95	.28	7	52.4	-.2			14	52.4	2.9	1.99	.53	8	52.4	-.8	.68	.24
13	15	51.1	-.6	1.59	.41	8	51.9	-.5			12	51.8	-.6	1.69	.49	10	52.4	.0	.66	.21
14	14	51.4	.3	.95	.25	10	52.0	.1			18	51.7	-.1	1.55	.36	8	52.0	-.4	.87	.31
15	15	51.1	-.3	.85	.22	5	52.2	.2			8	52.0	.3	1.73	.61	10	53.2	1.2	1.60	.51
16	18	50.3	-.8	1.60	.37	10	50.8	-1.4			10	52.9	.9	.94	.30	13	52.6	-.6	1.44	.39
17	19	51.2	.9	1.24	.28	6	52.2	1.4			18	51.7	-1.2	.85	.20	15	52.6	.0	.97	.25
18	20	51.8	.6	1.85	.41	4	50.8	-1.4			12	52.8	1.1	1.48	.42	12	53.1	.5	1.11	.32
19	21	51.5	-.3	1.36	.29	9	52.6	1.8			16	51.0	-1.8	2.76	.69	3	53.6	.5		
20+	536	51.4	-.1	1.68	.07	77	51.6	-1.0	1.94	.22	156	51.4	.4	1.90	.15	19	51.4	-2.2	2.75	.63
60+	54	50.3	-1.1	2.05	.28						24	49.9	-1.5	2.11	.43					

there is a tendency for this proportion to increase. However, the increase is not very great and in a very general sense the tendency is for this proportion to decrease with age. The sexual differences are also brought out more clearly in the curves of growth.

Arm Reach.

(Maximum)

Comparability of Results. Although we find greater differences in the averages of different observers the variability of this measurement is also considerable and the results probably comparable.

TABLE XXI.

Arm Reach: Averages for Different Observers.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	184.2	18	182.4	30	167.8	7	165.5
J. W. Cooke	172	179.5	14	182.0	32	167.7	2	163.0
G. A. Kaven	239	182.3	25	181.9	81	169.2	5	173.4
Z. T. Daniels	12	183.6	5	181.8	2	167.5		
F. Boas	34	184.9	8	183.2	3	167.5	2	170.5
C. A. Helvin and F. C. Kenyon	9	179.7	6	182.3	3	173.3	2	162.5
E. F. Wilson	18	176.8			3	158.0		
G. M. West					1	175.0	1	175.0
Total Series	535	181.4	76	182.2	155	168.3	19	167.4

Sex and Blood. There is a sexual difference of 13.7 cm., among the full-bloods and of 14.8 cm., among the half-bloods. There are no very marked differences in this dimension between full-bloods and half-bloods. In both instances the reach is considerably greater than stature. The distribution curves (Fig. 5) indicate the variability of this dimension. The full-bloods are more variable than the half-bloods. This is due to the very extreme cases.

Age and Growth. The curves of growth (Fig. 4) show that the full-bloods have a greater arm reach in a majority of the years. During the years 13 and 14 the females exceed the males. Apparently this dimension decreases slightly after 60 years of age.

TABLE XXII.

ARM REACH: DISTRIBUTION.

Cm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
150					1	.6		
2					1	.6		
4					4	2.6		
6	1	.2			3	1.9	1	5.3
8	0	.0			9	5.8	1	5.3
160	2	.4			6	3.8	1	5.3
2	4	.8			12	7.7	5	26.4
4	1	.2	2	2.6	12	7.7	1	5.3
6	5	.9	0	.0	9	5.8	2	10.6
8	7	1.3	0	.0	24	15.4	0	.0
170	14	2.6	2	2.6	21	13.6	2	10.6
2	28	5.2	3	3.9	21	13.6	1	5.3
4	41	7.7	5	6.5	12	7.7	2	10.6
6	44	8.3	7	9.1	8	5.1	2	10.6
8	61	11.4	6	7.8	6	3.8	0	.0
180	60	11.2	8	10.4	6	3.8	1	5.3
2	58	10.8	10	13.0				
4	60	11.2	10	13.0				
6	50	9.4	9	11.7				
8	32	6.0	2	2.6				
190	26	4.9	2	2.6				
2	16	3.0	5	6.5				
4	11	2.0	4	5.2				
6	6	1.1	0	.0				
8	5	.9	1	1.3				
200	2	.4						
2	1	.2						
4								
Average	181.4		182.4		168.3		167.4	
σ	±7.03		±6.99		±6.43		±6.79	
e	± .30		± .80		± .51		±1.55	
V in %	3.87		3.83		3.83		4.05	
No. of cases	535		76		155		19	

Mixed Indian

Average 7 men	178.6	3 females	166.0

TABLE XXIII.
Arm Reach: Growth.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	104.0									1	96.0								
5						1	117.0				1	102.0	6.0			1	108.0			
6	3	116.7	12.7	1.23	.71	4	119.0	2.0			4	123.5	21.5			2	117.5	9.5		
7	6	122.3	5.6	5.16	2.11	5	128.8	9.8			5	126.4	2.9			8	122.5	5.0		
8	4	133.5	11.2	2.18	1.08	2	126.5	–2.3			7	126.1	–.3			11	128.6	6.1		
9	13	134.0	.5	4.81	1.33	4	134.8	8.3			4	133.8	7.7			6	134.5	5.9		
10	13	135.8	1.8	5.39	1.49	12	140.0	5.2			10	137.3	3.5	5.83	1.87	11	134.4	–.1		
11	13	144.4	8.6	5.96		11	141.0	1.0			2	143.0	5.7			4	140.5	6.1		
12	11	151.6	7.2	7.36	2.22	7	149.6	8.6			14	150.5	7.5	6.51	1.74	8	147.8	7.3	5.64	1.99
13	15	156.2	4.6	8.78	2.26	8	154.1	4.5			12	156.1	5.6	6.94	2.00	10	155.4	7.6	4.73	1.49
14	14	159.9	3.7	5.37	1.43	10	158.4	4.3			19	162.0	5.9	7.40	1.69	8	162.4	7.0	4.61	1.63
15		169.2	9.3	4.71	1.21	5	169.6	11.2			8	167.0	5.0	6.22	2.20	10	164.8	2.4	8.03	2.54
16	15	171.3	2.1	5.81	1.37	10	176.1	6.5			10	167.2	.2	2.60	.82	12	164.6	–.2	5.70	1.64
17	18	178.2	6.9	4.25	.97	6	178.0	1.9			18	167.9	.7	5.17	1.21	15	167.6	3.0	5.10	1.31
18	19	178.8	.6	5.00	1.12	4	179.0	1.0			12	164.6	–3.3	6.63	1.91	12	164.7	–2.9	5.38	1.61
19	20	183.8	5.0	6.70	1.49	9	180.1	1.1			16	168.5	3.9	4.69	1.17	3	166.0	1.3		
20+	535	181.4	–2.4	7.03	.30	76	182.2	2.1	6.99	.80	155	168.3	–.2	6.43	.51	19	167.4	1.4	6.79	1.55
60+	54	177.9	–3.5	6.41	.87						24	166.8	–1.5	5.42	1.10					

Index of Arm Reach.

Comparability of Results. As in the absolute arm reach, so too in the relative arm reach, we get fairly large differences between the averages of the series of different observers. However, the larger series shows a fair degree of uniformity.

TABLE XXIV.

Index of Arm Reach: Averages for Different Observers.

Observers	Male				Female			
	Pure Sioux		Half-bloods		Pure-Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	48	105.3	18	105.0	30	104.4	7	104.4
J. W. Cooke	171	104.5	14	105.3	32	105.0	2	101.0
G. A. Kaven	239	105.5	25	105.2	82	105.7	5	104.6
Z. T. Daniels	12	105.6	5	103.8	2	106.0		
F. Boas	34	106.7	8	104.9	3	105.3	2	104.0
C. A. Helvin and F. C. Kenyon	9	105.1	6	105.0	3	105.3	2	103.0
E. F. Wilson	18	105.0			3	103.7		
G. M. West					1	108.0	1	105.0
Total Series	531	105.2	76	105.0	156	105.3	19	103.8

Sex and Blood. The distribution of this character in Table XXV and Fig. 7 does not bring out any very marked differences. The frequency curve for half-bloods is more regular than that of the full-bloods and the variability is much smaller. The relative arm reach for both full-bloods and half-bloods is rather great. The full-bloods have a slightly greater reach than the half-bloods. Although the difference is small it is consistent and more clearly brought out by the averages for children of different ages.

Age and Growth. The curve of growth (Fig. 3) shows more clearly that the full-bloods have a greater relative arm reach than the half-bloods for nearly every year. As usual the sex differences are most noticeable after the fifteenth year. The general tendency of this proportion is to increase with age.

TABLE XXV.

INDEX OF ARM REACH: DISTRIBUTION.

Cm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
95	1	.2						
6	1	.2						
7	1	.2			1	.6		
8	2	.4			0	.0		
9	2	.4	1	3.1	1	.6		
100	4	.8	0	.0	2	1.3	1	5.3
1	15	2.8	2	2.6	5	3.2	0	.0
2	34	6.4	6	7.8	7	4.5	4	21.0
3	69	13.0	7	9.1	15	9.6	3	15.8
4	73	13.7	15	19.8	26	16.6	4	21.0
5	80	15.0	16	21.0	25	16.0	3	15.8
6	89	16.7	12	15.8	32	20.5	3	15.8
7	64	12.0	9	11.8	11	7.1	1	5.3
8	54	10.2	4	5.2	18	12.2		
9	26	4.9	1	1.3	9	5.4		
110	12	2.2	2	2.6	2	1.3		
11	3	.6	0	.0	1	.6		
12	1	.2	1	1.3				
Average	105.2		105.0		105.3		103.8	
σ	±2.41		±2.19		±2.32		±1.75	
e	± .10		± .25		± .19		± .40	
V in %	2.29		2.09		2.11		1.68	
No. of cases	531		76		156		19	

Mixed Indian

Average 7 men	105.2	3 women	104.6

LENGTH OF ARM.

Comparability of Results. The averages for the series of different observers are very similar. Yet when we consider the technique involved in obtaining this measurement it seems probable that the measurement is not very accurate.

Sex and Blood and Growth. The sex difference is 5.2 cm. for full-bloods and 6.3 cm. for half-bloods. This measurement also does not show any very great differences for the different groups. In proportion

TABLE XXVI.

Index of Arm Reach: Growth.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	101.0									1	99.0								
5						1	101.0				1	95.0	-4.0			1	97.0			
6	3	104.7	3.7			4	103.8	2.8			4	102.7	7.7			2	103.5	6.5		
7	6	103.0	-1.7			5	102.8	-1.0			4	103.0	.3			8	103.5	.0		
8	4	104.2	1.2			2	100.0	-2.8			7	104.1	1.1			11	102.1	-1.4		
9	13	102.0	-2.2	2.15	.59	3	102.3	2.3			4	103.7	-.4			6	102.6	.5		
10	13	102.5	.5	2.26	.63	12	102.7	.4			10	102.3	-.4	3.23	1.02	11	103.3	.7		
11	13	103.4	.9	1.44	.40	11	102.2	-.5			2	102.5	.2			4	102.5	-.8		
12	11	103.0	-.4	2.41	.72	7	102.4	.2			14	103.3	.8	2.54	.68	8	104.5	2.0	2.57	.91
13	15	103.2	.2	1.79	.46	8	103.2	.8			12	104.1	.8	2.14	.61	10	102.9	-1.6	2.30	.72
14	14	104.2	1.0	2.37	63	10	102.8	-.4			18	104.4	.3	2.00	.47	8	105.8	2.9	2.71	.95
15	15	105.0	.8	2.08	.53	5	105.2	2.4			8	105.6	1.2	1.94	.68	10	105.3	-.5	3.41	1.07
16	18	104.4	-.6	2.31	.54	10	106.0	.8			10	105.4	-.2	1.96	.61	13	104.5	-.8	2.30	.63
17	19	107.1	2.7	1.80	.41	6	105.3	-.7			18	104.8	-.6	1.68	.39	15	104.3	-.2	1.93	.50
18	20	106.1	-1.0	2.41	.54	4	105.2	-.1			12	104.5	-.3	2.63	.75	12	104.3	.0	2.35	.68
19	20	106.4	.3	2.13	.47	9	105.2	.0			16	105.2	.7	1.88	.46	3	103.6	-.7		
20+	531	105.2	-1.2	2.41	.10	76	105.0	-.2	2.19	.25	156	105.3	.1	2 32	.19	19	103.8	.2	1.75	.40
60+	54	104.7	-.5	2.34	.32						24	105.6	.3	2 38	.48					

TABLE XXVII.
LENGTH OF ARM: AVERAGES FOR DIFFERENT OBSERVERS.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	77.3	18	78.0	30	71.0	7	69.9
J. W. Cooke	171	76.7	14	76.4	33	72.7	2	68.5
G. A. Kaven	241	77.2	26	77.2	81	71.7	5	72.8
Z. T. Daniels	12	77.4	5	78.0	2	70.0		
F. Boas	34	77.7	8	77.9	3	71.3	2	74.5
C. A. Helvin and F. C. Kenyon	9	76.8	6	77.5	3	74.0	2	68.5
E. F. Wilson	17	75.6			3	67.7		
G. M. West					1	82.0	1	73.0
Total Series	535	77.0	77	77.3	156	71.8	19	71.0

TABLE XXVIII.
LENGTH OF ARM: DISTRIBUTION.

Cm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
64	2	.4			3	1.9	1	5.3
6	1	.2	1	1.3	19	12.2	2	10.6
8	10	1.9	0	.0	16	10.2	5	26.4
70	20	3.7	2	2.6	37	23.7	2	10.6
2	45	8.4	7	9.1	33	21.1	4	21.0
4	87	16.2	11	14.2	27	17.2	3	15.8
6	131	24.5	15	19.5	12	7.7	1	5.3
8	110	20.5	26	33.9	7	4.5	1	5.3
80	82	15.4	7	9.1	0	.0		
2	27	5.0	6	7.8	1	.6		
4	14	2.6	1	1.3	0	.0		
6	4	.7	1	1.3	0	.0		
8	0	.0			1	.6		
90	1	.2						
2	0	.0						
4	1	.2						
Average	77.0		77.3		71.8		71.0	
σ	$\pm$3.57		$\pm$3.28		$\pm$3.63		$\pm$3.59	
e	$\pm$ .15		$\pm$ .37		$\pm$ .29		$\pm$ .82	
V in %	4.64		4.24		5.05		5.05	
No. of cases	535		77		156		19	

Mixed Indian

Average 7 men 76.1 3 women 71.3

TABLE XXIX.

Length of Arm: Growth.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	43.0									1	41.0								
5						1	46.0				2	46.0	5.0			1	43.0			
6	3	50.0	7.0			4	49.2	3.2			4	53.2	7.2			2	50.0	7.0		
7	6	52.0	2.0	2.88	1.17	5	54.6	5.4			5	53.2	.0			8	51.3	1.3		
8	4	56.8	4.8	1.93	.96	2	53.0	–1.6			7	53.7	.5			11	55.0	3.7		
9	13	57.2	.4	2.16	.59	4	58.0	5.0			4	57.2	3.5			6	57.5	2.5		
10	13	58.2	1.0	2.14	.59	12	60.2	2.2			10	58.6	1.4	3.01	.95	11	57.2	–.3		
11	13	60.9	1.7	1.86	.52	11	61.1	.9			2	61.5	2.9			4	60.5	3.3		
12	11	65.0	4.1	3.43	1.03	7	63.9	2.8			14	64.2	2.7	3.26	.87	8	63.0	2.5	2.87	1.01
13	15	67.2	2.2	6.58	1.70	8	65.4	1.5			12	65.9	1.7	2.75	.79	10	65.0	2.0	1.25	.39
14	14	68.3	1.1	2.28	.61	10	68.9	3.5			19	69.3	3.4	3.41	.78	8	68.5	3.5	2.06	.72
15	15	72.5	4.2	2.52	.65	5	71.4	2.5			8	70.1	.8	3.06	1.08	10	70.2	1.7	2.89	.91
16	18	73.8	1.3	3.52	.83	10	74.9	3.5			10	71.1	1.0	.94	.29	13	70.3	.1	4.06	1.12
17	19	76.0	2.2	3.06	.70	6	76.0	1.1			18	72.2	1.1	2.75	.65	15	71.6	1.3	2.99	.77
18	20	76.4	.4	3.88	.86	4	76.0	.0			12	69.9	–2.3	2.46	.71	12	71.2	–.4	3.30	.95
19	21	77.8	1.4	3.25	.71	9	76.4	.4			16	71.6	1.7	2.43	.61	3	73.0	1.8		
20+	535	77.0	–.8	3.57	.15	77	77.3	.9	3.28	.37	156	71.8	.2	3.63	.29	19	71.0	–2.0	3.59	.82
60+	54	76.9	–.1	3.80	.52						24	71.7	–.1	3.29	.67					

to the body height the full-bloods have slightly longer arms. Again the half-bloods are relatively and absolutely less variable in this character than the full-bloods. The curve of growth (Fig. 4) shows nothing of special interest.

Index of Arm Length

Comparability of Results. The results of the different observers are very uniform.

TABLE XXX.

Index of Arm Length: Averages of Different Observers.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No	Average
F. C. Smith	51	44.5	18	44.7	30	44.5	7	44.3
J. W. Cooke	171	44.7	14	44.2	33	45.4	2	43.0
G. A. Kaven	238	44.7	26	44.6	82	44.8	5	44.0
Z. T. Daniels	12	44.5	5	44.6	2	44.0		
F. Boas	34	44.7	8	44.4	3	44.7	2	45.0
C. A. Helvin and F. C. Kenyon	9	45.1	6	44.7	3	45.0	2	44.0
E. F. Wilson	17	44.8			3	44.3		
G. M. West					1	50.0	1	44.0
Average	532	44.6	77	44.6	157	44.9	19	44.1

Sex, Blood, Age. There are no striking differences in these characters. The curve of growth would seem to indicate that the full-bloods had slightly longer arms. The greater number of extreme cases in both the male and female full-bloods makes the variability greater than that of the half-bloods.

Length of Head.

Comparability of Results. There seem to be quite marked differences between the averages of some of the larger series. However, this diameter is quite variable and the results probably comparable.

Sex and Blood. The sexual difference for full-bloods is 7.4 mm., and for half-bloods 7.1 mm. Although very small, this difference seems to persist throughout. In the case of the males the full-bloods

TABLE XXXI.

Index of Arm Length: Distribution.

	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
34	1	.2						
5	0	.0						
6	0	.0						
7	0	.0						
8	0	.0			1	.6		
9	1	.2			0	.0		
40	2	.4			0	.0		
1	1	.2	1	1.3	0	.0		
2	22	4.0	4	5.2	6	3.8	2	10.6
3	72	13.5	7	9.1	17	10.8	4	21.0
4	142	26.5	25	32.5	40	25.5	7	36.4
5	148	27.7	25	32.5	46	29.2	3	15.8
6	99	18.6	10	13.0	30	19.1	2	10.6
7	23	4.3	4	5.2	8	5.1	1	5.3
8	14	2.6	1	1.3	5	3.2		
9	4	.8			1	.6		
50	1	.2			2	1.3		
1	2	.4			0	.0		
2					0	.0		
3					1	.6		
Average	44.6		44.6		44.9		44.1	
σ	±1.47		±1.26		±1.68		±1.29	
e	± .06		± .17		± .13		± .29	
V in %	3.29		2.82		3.75		2.93	
No. of cases	532		77		157		19	

Mixed Indian

Average of 7 men 45.1 3 women 44.3

have the larger head and in the case of the females the half-bloods have the longer heads. The children show the same results. This character is quite variable throughout all the series. There seems to be a large number of extreme cases. However, the distribution among male half-bloods is more irregular than among the full-bloods and the variability greater. The female full-bloods are also very variable.

TABLE XXXII.

Index of Arm Length: Growth.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	42.0									1	42.0								
5						1	41.0				2	41.5	-.5			1	39.0			
6	3	45.0	3.0			4	43.0	2.0			4	44.2	2.7			2	44.0	5.0		
7	6	43.4	-1.6			5	43.8	.8			4	43.5	-.7			8	43.6	-.4		
8	4	44.5	1.1			2	41.5	-2.3			7	44.4	.9			11	43.6	.0		
9	13	43.4	-1.1	1.14	.31	3	43.3	1.8			4	44.5	.1			6	43.5	-.1		
10	13	43.9	.5	1.03	.29	12	44.2	.9			10	43.9	-.6	1.81	.57	11	44.0	.5		
11	13	43.6	-.3	1.07	.30	11	44.1	-.1			2	43.0	-.9			4	44.7	.7		
12	11	44.2	.6	1.64	.49	7	44.0	-.1			14	44.6	1.6	1.79	.47	8	44.4	-.3	.84	.29
13	15	44.4	.2	2.36	.61	8	43.9	-.1			12	43.9	-.7	1.03	.29	10	43.1	-1.3	2.07	.65
14	14	44.5	.1	.98	.26	10	44.8	.9			18	44.5	.6	1.17	.27	8	44.8	1.7	.84	.29
15	15	45.0	.5	1.55	.40	5	44.4	-.4			8	44.8	.3	.98	.35	10	44.9	.1	1.58	.49
16	18	44.8	-.2	1.72	.40	10	45.0	.6			10	45.0	.2	1.00	.31	13	44.9	.0	1.64	.45
17	19	45.5	.7	1.32	.30	6	45.0	.0			18	44.9	-.1	.96	.22	15	44.3	-.6	1.28	.33
18	20	45.4	-.1	1.97	.44	4	44.8	-.2			12	44.3	-.6	1.16	.33	12	44.9	.6	1.44	.41
19	21	45.0	-.4	1.07	.23	9	44.4	-.4			16	45.1	.8	1.69	.42	3	45.6	.7		
20+	532	44.6	-.4	1.47	.06	77	44.6	.2	1.26	.17	157	44.9	-.2	1.68	.13	19	44.1	-1.5	1.29	.29
60+	54	45.4	.8	1.35	.18						24	45.5	.6	1.99	.41					

TABLE XXXIII.

Length of Head: Averages for Different Observers.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	195.0	18	194.7	30	186.8	7	185.6
J. W. Cooke	174	196.1	14	196.6	32	187.5	2	190.0
G. A. Kaven	241	193.9	26	193.2	82	185.2	5	187.2
Z. T. Daniels	12	195.0	5	196.2	2	190.0		
F. Boas	34	194.3	8	196.2	3	184.7	2	186.5
C. A. Helvin and F. C. Kenyon	9	192.3	6	189.7	3	188.6	2	188.5
E. F. Wilson	18	196.9			3	181.7		
G. M. West					1	191.0	1	193.0
Total Series	539	194.9	77	194.4	156	187.0	19	187.3

Age and Growth. The heads of the males are longer throughout. As mentioned before the full-blood males and the half-blood females have the longer heads for nearly every year. The total growth in this diameter from the eighth to the twentieth year is very small.

Width of Head.

Comparability of Results. Again we find considerable differences in the averages of different observers. This doubtless indicates slight differences in technique but on the whole the results are comparable.

Sex and Blood. The sexual difference among full-bloods is 4.2 mm. and 4.0 mm., among half-bloods. The half-bloods are considerably less variable in head width than the full-bloods. Again this seems to be due to fewer extreme cases rather than a more regular distribution within the curve proper. The full-bloods have very slightly wider heads

Growth. The curve of growth (Fig. 4) for this character is very similar to that for length of head. The half-bloods stand intermediate between the male and female full-bloods. The male full-bloods have a wider head throughout, while the female half-bloods exceed the female full-bloods until the seventeenth year when the full-bloods have the wider head.

TABLE XXXIV.

LENGTH OF HEAD: DISTRIBUTION.

Cm	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
164	1	.2						
6	0	.0						
8	0	.0						
170	0	.0						
2	0	.0						
4	0	.0			2	1.3		
6	0	.0	1	1.3	2	1.3	1	5.3
8	3	.6	1	1.3	7	4.5	1	5.3
180	6	1.1	1	1.3	18	11.6	0	.0
2	6	1.1	2	2.6	15	9.6	0	.0
4	21	3.9	3	3.9	15	9.6	4	21.0
6	22	4.1	3	3.9	19	12.2	2	10.6
8	30	5.6	8	10.4	19	12.2	3	15.8
190	64	11.8	7	9.1	35	22.5	7	37.0
2	64	11.8	7	9.1	9	5.8	1	5.3
4	76	14.2	7	9.1	10	6.4		
6	72	13.4	11	14.3	2	1.3		
8	57	10.6	11	14.3	2	1.3		
200	45	8.4	3	3.9	1	.6		
2	27	5.0	6	7.8				
4	23	4.3	1	1.3				
6	14	2.6	1	1.3				
8	2	.4	2	2.6				
210	4	.7	1	1.3				
12	0	.0	1	1.3				
14	1	.2						
16	0	.0						
18	1	.2						
Average	194.9		194.4		187.0		187.3	
σ	±6.16		±7.12		±5.09		±4.17	
e	± .26		± .81		± .41		± .96	
V in %	3.16		3.66		2.72		2.22	
No. of cases	539		77		156		19	

Mixed Indian

Average for 7 men 194.0 3 women 189.3

TABLE XXXV.

Length of Head: Growth.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	175.0									1	166.0								
5						1	189.0				2	174.5	8.5			1	179.0			
6	3	172.3	-2.7			4	177.5	-11.5			4	179.5	5.0			2	172.5	-6.5		
7	6	177.2	4.9	4.13	1.68	5	179.2	1.7			5	174 4	-5.1			8	174.8	2.3		
8	4	183.5	6.3			2	179.0	-.2			7	178.7	4.3			11	179.6	4.8		
9	13	183.4	-.1	4 13	1.14	4	178.8	-.2			4	178.8	.1			7	181.1	1.5		
10	13	181.4	-2.0	4.52	1.25	12	183.2	4 4			10	177.3	1.5	6.34	2.00	11	177.9	-3.2		
11	13	184.3	2.9	6.21	1.72	11	182.9	.7			2	178.0	.7			4	180.5	2.6		
12	11	188.1	3.8	4.84	1.45	7	183.6	.7			14	181 2	3.2	4.49	1.19	8	184.5	4.0	3.38	1.19
13	15	194.9	-3.2	4.65	1.19	8	183.0	-.6			12	181.2	.0	5.27	1.51	10	184.6	.1	6.50	2.05
14	14	186.7	1.8	5.68	1.51	10	185.5	2.5			19	184.5	2.3	4.30	.98	8	184.0	-.6	4.72	1.66
15	15	186.3	-.4	6.39	1.65	5	188.0	2.5			8	185.9	1.4	6.92	2.44	10	188.1	4.1	4.66	1.47
16	18	188.9	1.6	5.67	1.33	10	191.0	3.0			10	185.5	-.4	4.67	1.47	13	188.4	.3	3.95	1.09
17	19	188.9	.0	4.44	.99	6	190.5	-.5			18	184.7	-.8	5.04	1.18	15	186.1	-2.3	3.41	.88
18	20	187.7	-1.2	4.75	1.06	4	188.0	-2.5			12	184.3	-.4	4.46	1.28	12	185.2	-.9	5.10	1.47
19	21	193.2	5.5	3.97	.86	9	189.6	1.6			16	182.6	-1.7	3.86	.96	3	183.3	-1.9		
20+	539	194.9	1.7	6.16	.26	77	194.4	4.8	7.12	.81	156	187.0	4.4	5.09	1.41	19	187.3	4.0	4.17	.96
60+	55	194.8	-.1	5.42	.73						24	185.6	1.4	8.75	0.74					

TABLE XXXVII.

WIDTH OF HEAD: DISTRIBUTION.

Mm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
134	1	.2						
6	0	.0						
8	1	.2	1	1.3				
140	0	.0	1	1.3	4	2.5		
2	2	.4	0	.0	7	4.4	2	10.6
4	8	1.5	2	2.6	11	7.0	1	5.3
6	29	5.4	3	3.9	19	12.1	1	5.3
8	21	3.9	5	6.5	19	12.1	3	15.8
150	70	13.0	7	9.1	23	14.8	5	26 4
2	79	14.6	13	17.0	30	19.2	3	15.8
4	92	17.0	12	15.6	18	11.5	2	10.6
6	75	14.0	14	18.2	11	7.0	1	5.3
8	50	9.3	9	11.6	8	5.1	0	.0
160	53	9.9	3	3.9	5	3.2	1	5.3
2	25	4.6	6	7.8	2	1.3		
4	14	2.6	1	1.3				
6	10	1.9						
8	3	.6						
170	2	.4						
2	2	.4						
4	1	.2						
6	0	.0						
8	0	.0						
180	0	.0						
2	1	.2						
Average	155.1		154.3		150.9		150.3	
σ	±5.39		±5.04		±4.83		±4.50	
e	± .23		± .57		± .38		±1.03	
V in %	3.47		3.26		3.20		2.99	
No. of cases	539		77		157		19	

Mixed Indian

Average for 7 men	155.8	3 women	152.4

TABLE XXXVIII.

WIDTH OF HEAD: GROWTH.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	146.0									1	138.0								
5						1	141.0				2	141.5	3.5			1	148.0			
6	3	145.0	-1.0			4	142.2	1.2			4	142.8	1.3			2	140.5	-7.5		
7	6	143.8	-1.2	4.80	1.96	5	144.8	2.6			5	142.0	-.8			8	141.0	.5		
8	4	146.2	2.4			2	146.0	1.2			7	142.8	.8			11	145.1	4.1		
9	13	146.8	.6	4.62	1.28	4	140.8	-5.2			4	144.8	2.0			7	146.0	.9		
10	13	146.2	-.6	3.07	.85	12	146.3	5.5			10	142.9	-1.9	3.24	1.02	11	141.4	-4.5		
11	13	146.6	.4	4.79	1.32	11	145.7	-.6			2	140.0	-2.9			4	145.0	3.6		
12	11	149.4	2.8	3.43	1.03	7	148.7	3.0			14	145.1	5.1	6.67	1.78	8	146.5	1.5	4.03	1.42
13	15	148.0	-1.4	5.43	1.40	8	147.0	-1.7			12	147.2	2.1	2.07	.60	10	148.5	2.0	3.77	1.19
14	14	150.0	2.0	5.66	1.51	10	148.4	1.4			18	148.0	.8	4.40	1.04	8	148.9	.4	4.20	1.48
15	15	152.8	2.8	4.85	1.25	5	149.8	1.4			8	147.8	-.2	3.44	1.21	10	151.3	2.4	6.94	2.19
16	18	151.3	-1.5	4.67	1.09	10	153.5	4.7			10	148.0	.2	2.32	.73	13	149.9	-1.4	3.15	.87
17	19	151.3	.0	4.35	.99	6	151.5	-2.0			18	150.4	2.4	5.67	1.34	15	148.5	-1.4	3.92	1.00
18	20	153.1	1.8	5.05	1.12	4	151.8	.3			12	150.1	-.3	4.80	1.38	12	148.8	.3	3.46	.99
19	21	153.9	.8	4.85	1.05	9	151.8	.0			16	150.4	.3	4.84	1.21	3	147.3	1.5		
20+	539	155.1	1.2	5.39	.23	77	154.3	2.5	5.04	.57	151	150.9	.5	4.83	.38	19	150.3	3.0	4.50	1.03
60+	55	155.4	.3	4.16	.56						24	150.3	-.6	4.31	.88					

TABLE XXXVI.

WIDTH OF HEAD: AVERAGES FOR DIFFERENT OBSERVERS.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	156.5	18	155.3	30	151.7	7	151.3
J. W. Cooke	174	156.2	14	156.5	33	104.4	2	150.0
G. A. Kaven	241	153.9	26	152.5	82	150.7	5	150.2
Z. T. Daniels	12	159.3	5	156.4	2	159.0		
F. Boas	34	155.6	8	154.4	3	150.7	2	145.5
C. A. Helvin and F. C. Kenyon	9	154.3	6	151.8	3	151.6	2	152.5
E. F. Wilson	18	154.6			3	150.7		
G. M. West					1	149.0	1	150.0
Total Series	539	155.1	77	154.3	157	150.9	19	150.3

CEPHALIC INDEX.

Comparability of Results. The results for the cephalic index in the different series are undoubtedly comparable.

Sex and Blood. The females have slightly shorter heads, the sexual differences being 0.9 for full-bloods and 1.1 for half-bloods. The averages for full-bloods and half-bloods are almost identical. Again we find the full-blood males more variable than the half-bloods and for the same reason that we have more marginal cases among them. However, these results show clearly that it is dangerous to rely wholly on the variability of the cephalic index as a test for racial intermixture. It must be inferred from these results that the groups with whom these Indians have mixed have had very similar head proportions. Nor could the absolute diameters have been very different.

Growth. The general trend is for a decrease in this proportion with increasing age. The females have a shorter head throughout with the exception of ages 14, 15, and 16.

WIDTH OF FACE.

(Maximum)

Comparability of Results. On the whole the results of different observers are very similar and the personal equation is undoubtedly not very large.

TABLE XXXIX.

CEPHALIC INDEX: AVERAGES FOR DIFFERENT OBSERVERS.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	80.3	18	79.8	30	80.8	7	81.4
J. W. Cooke	173	79.6	14	79.7	32	79.9	2	80.5
G. A. Kaven	241	79.4	26	79.0	82	80.5	5	80.4
Z. T. Daniels	12	81.9	5	79.4	2	83.5		
F. Boas	34	80.3	8	78.6	3	81.3	2	82.0
C. A. Helvin and F. C. Kenyon	9	80.2	6	80.2	3	80.3	2	81.0
E. F. Wilson	17	79.4			3	79.0		
G. M. West					1	78.0	1	78.0
Total Series	537	79.6	77	79.4	156	80.5	19	80.5

Sex and Blood. The sexual difference in the width of the face is 6.3 mm. for the full-bloods and 4.3 mm. for the half-bloods. As has already been pointed out by Professor Boas on many occasions, the greater width of the face is one of the most conspicuous differences between full-bloods, half-bloods, and whites. The average difference between full-blood and half-blood males in this series is 5.7 mm. This constitutes a real mathematical difference and one which is consistent throughout for males and females, children and adults. Although the half-bloods are only very slightly more variable in this character the distribution in the two cases is quite different. As will be noticed in Fig. 6 the half-bloods form a mode on either side of the mean and median. The higher mode at least, corresponds fairly closely to the mean and mode of the full-blooded Indian. This distribution would seem to indicate that the inheritance of facial width is alternating.[1]

Growth. The racial difference is more clearly noticeable after the seventeenth year while the sexual differences are most marked after the fifteenth year. The width of the face seems to increase somewhat more than the width of the head during the period from the sixth to the twentieth year.

[1]For a further discussion of the inheritance of face width see Section IV, p. 159.

TABLE XL.

Cephalic Index: Distribution.

Cm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
70	1	.2						
1	1	.2						
2	4	.7			1	.6		.6
3	5	.9			1	.6		
4	13	2.4	3	3.9	1	.6		
5	12	2.2	2	2.6	4	2.5	1	5.3
6	47	8.7	8	10.4	7	4.5	1	5.3
7	37	6.9	7	9.1	4	2.5	0	.0
8	83	15.4	7	9.1	16	10.2	3	15.8
9	72	13.4	9	11.7	16	10.2	1	5.3
80	70	13.0	12	15.6	23	14.8	5	26.4
1	48	9.0	12	15.6	25	16.0	2	10.6
2	53	9.9	11	14.3	25	16.0	2	10.6
3	32	6.0	4	5.2	14	9.0	1	5.3
4	26	4.8	0	.0	11	7.0	0	.0
5	11	2.0	1	1.3	5	3.2	2	10.6
6	13	2.4	0	.0	1	.6	1	5.3
7	1	.2	0	.0	2	1.3		
8	0	.0	1	1.3				
9	4	.7						
90	3	.6						
1	0	.0						
2	0	.0						
3	0	.0						
4	0	.0						
5	1	.2						
Average	79.6		79.4		80.5		80.5	
σ	± 3.20		± 2.64		± 2.68		± 2.85	
e	$\pm$ .14		$\pm$ .30		$\pm$ .22		$\pm$ .65	
V in %	4.03		3.33		3.33		3.54	
No. of cases	537		77		156		91	

Mixed Indian

Average for 7 men	80.4	3 women	80.4

TABLE XLI.

Cephalic Index: Growth.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	83.0									1	83.0								
5						1	75.0				2	81.5	–1.5			1	83.0			
6	3	84.7	1.7			4	80.0	5.0			4	79.5	–2.0			2	81.5	–1.5		
7	6	81.2	–3.5			5	80.4	.4			4	32.7	3.2			8	80.8	–.7		
8	4	79.8	–1.4			2	81.2	.8			7	80.0	–2.7			11	80.9	.1		
9	13	80.0	.2	2.38	.66	3	80.3	–.9			4	81.0	1.0			7	79.4	–1.5		
10	13	80.5	.5	2.43	.67	12	80.0	–.3			10	80.8	–.2	2.32	.73	11	79.7	.3		
11	13	79.5	–1.0	2.73	.75	11	79.6	–.4			2	78.5	–2.3			4	80.2	.5		
12	11	79.5	.0	2.36	.71	7	80.1	.5			14	80.1	1.6	4.82	1.28	8	79.6	–.6	1.72	.61
13	14	80.3	.8	3.51	.93	8	80.4	.3			12	81.3	.2	2.02	.58	10	80.8	1.2	2.82	.89
14	14	80.4	.1	2.53	.67	10	80.3	–.1			18	79.9	–1.4	2.48	.58	8	80.9	.1	2.80	.99
15	15	81.7	1.3	3.01	.77	5	80.2	–.1			8	79.6	–.3	2.86	1.01	10	80.5	–.4	3.56	1.12
16	18	80.1	–1.6	3.26	.76	10	80.4	.2			10	79.9	.3	2.12	1.42	13	79.5	–1.0	1.81	.50
17	19	80.3	.2	2.74	.62	6	79.5	–.9			18	81.2	1.3	2.81	.66	15	79.8	.3	2.67	.81
18	20	81.0	.7	2.30	.51	4	80.5	1.0			12	81.4	.2	2.63	.76	12	80.3	.5	2.24	.64
19	21	79.4	–1.6	3.16	.69	9	80.1	–.4			16	82.3	.9	3.16	.79	3	80.6	.3		
20+	537	79.6	.2	3.20	.14	77	79.4	–.7	2.64	.30	156	80.5	–1.8	2.68	.22	19	80.5	–.1	2.85	.65
60+	55	80.0	.4	3.13	.42						24	80.5	.0	3.10	.63					

TABLE XLII.

WIDTH OF FACE: AVERAGES FOR DIFFERENT OBSERVERS.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	150.3	18	145.9	30	143.1	7	140.4
J. W. Cooke	173	150.8	14	143.9	33	143.8	2	138.5
G. A. Kaven	241	148.4	25	142.7	82	142.6	5	138.8
Z. T. Daniels	12	148.0	5	139.2	2	141.5		
F. Boas	34	148.1	8	142.5	3	141.0	2	137.0
C. A. Helvin and F. C. Kenyon	9	145.4	6	141.7	3	148.7	2	137.5
E. F. Wilson	18	144.1			3	132.4		
G. M. West					1	145.0	1	140.0
Total Series	538	149.1	76	143.4	157	142.8	19	139.3

FACIAL WIDTH AND HEAD WIDTH.

(Cephalo-Facial Index.)

Comparabiliy of Results. The averages for the larger series are very similar.

Sex and Blood. The sexual differences in the cephalo-facial index, which expresses the width of the face in terms of proportionate width of the head, are not as marked as the differences due to race. Even in the full-blooded females this index is higher than in half-blood males.[1] Among full-bloods the sex difference is 1.4 and among half-bloods only 0.4. The male half-bloods are slightly more variable than the full-bloods although the curves in both cases are very similar.

Age and Growth. The curve of growth for this index brings out very clearly the differences in the amount and rate of growth in the transverse diameter of the head and the corresponding diameter of the face. The face becomes proportionately much wider than the head during the period of growth.

[1]Cf. Jenks, 1916.

TABLE XLIII.

WIDTH OF FACE: DISTRIBUTION.

Mm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
130			1	1.3	6	3.8		
2			1	1.3	3	1.9		
4	3	.6	4	5.3	8	5.1	4	21.0
6	3	.6	6	7.9	3	1.9	4	21.0
8	8	1.5	8	10.5	13	8.3	2	10.6
140	32	6.0	10	13.2	28	17.8	3	15.8
2	35	6.5	10	13.2	21	13.4	3	15.8
4	58	10.8	5	6.6	29	18.6	1	5.3
6	77	14.4	10	13.2	18	11.4	2	10.6
8	69	12.8	12	15.7	16	10.2		
150	88	16.4	6	7.9	9	5.7		
2	53	9.9	1	1.3	2	1.3		
4	41	7.6	0	.0	1	.6		
6	34	6.3	1	1.3				
8	16	2.9	1	1.3				
160	9	1.7						
2	3	.6						
4	4	.8						
6	1	.2						
8	1	.2						
170								
Average	149.1		143.4		142.8		139.3	
σ	±5.45		±5.49		±5.05		±3.70	
e	± .23		± .63		± .40		± .85	
V in %	3.65		3.83		3.53		2.65	
No. of cases	538		76		157		19	

Mixed Indian

Average for 7 men	149.3	3 women	141.6

HEIGHT OF FACE: PHYSIOGNOMIC

(Hair-line to Chin)

Comparability of Results. There are no real differences between the averages of the different observers. But this diameter is rather more variable than the width of the face. This is undoubtedly due to the

TABLE XLIV.

Width of Face: Growth.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	121.0									1	112.0								
5						1	108.0				2	120.5	8.5			1	120.0			
6	3	119.6	–1.4			4	119.0	11.0			4	120.5	.0			2	117.0	–3.0		
7	6	122.0	2.4			5	121.4	2.4			5	120.6	.1			8	116.6	–.4		
8	4	124.8	2.8			2	119.5	–1.9			7	123.3	2.7			11	122.7	6.1		
9	13	126.2	1.4	4.79	1.33	4	124.0	4.5			4	124.5	1.2			7	124.2	1.5		
10	13	126.4	.2	4.20	1.16	12	125.3	1.3			10	124.3	–.2				123.8	–.4		
11	13	127.3	.9	3.17	.88	11	124.7	–.6			2	125.5	1.2			3	126.0	2.2		
12	11	129.5	2.2	4.88	1.17	7	132.6	7.9			14	131.0	5.5	4.29	1.14	8	132.1	6.1	5.62	1.98
13	15	133.0	3.5	3.80	.99	8	133.1	.5			12	133.7	2.7	3.98	1.14	10	132.5	.4	3.77	1.19
14	14	134.0	1.0	3.54	.95	10	132.3	–.8			18	136.3	2.6	5.08	1.19	8	132.1	–.4	6.53	2.30
15	15	136.5	2.5	6.31	2.55	5	135.2	2.9			8	138.8	2.5	4.59	1.62	10	135.0	2.9	5.57	1.76
16	18	138.5	2.0	4.28	1.01	10	140.3	5.1			10	139.4	.6	3.69	1.16	13	135.8	.8	4.74	1.31
17	19	140.4	1.9	4.90	1.12	4	142.5	2.2			18	138.2	–1.2	5.62	1.32	15	136.2	.4	4.58	1.18
18	20	142.6	2.2	6.30	1.41	4	140.8	–1.7			12	142.6	4.0	6.04	1.74	12	135.3	–.9	3.94	1.13
19	21	145.0	2.4	4.22	.92	9	140.2	–.6			16	140.1	–2.5	5.52	1.37	3	141.0	5.7		
20+	538	149.1	4.1	5.45	.23	76	143.4	3.2	5.49	.63	157	142.8	2.7	5.05	.40	19	139.3	–1.7	3.70	.85
60+	55	150.7	1.6	4.62	.62						24	141.3	–1.5	4.78	.98					

TABLE XLV.

Cephalo-Facial Index: Average for Different Observers.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	96.1	18	93.8	30	94.4	7	92.0
J. W. Cooke	170	96.6	14	92.5	32	95.6	2	90.5
G. A. Kaven	242	96.3	26	93.2	82	84.9	5	90.0
Z. T. Daniels	12	92.7	5	89.2	2	88.0		
F. Boas	34	95.1	8	92.5	3	93.7	2	94.0
C. A. Helvin and F. C. Kenyon	9	94.3	6	93.3	3	98.0	2	91.0
E. F. Wilson	18	93.2			3	90.0		
G. M. West					1	97.0	1	93.0
Total Series	536	96.1	77	92.9	156	94.7	19	92.5

difficulty in taking the measurement from exactly the same points in each case. However, the differences due to personal errors on the part of the observers are less than in the case of the anatomical face height.

Sex and Blood. The sexual difference in this measurement is quite marked being 10.5 mm. for full-bloods and 12.8 mm. for half-bloods. The full-bloods in both instances have the higher faces. The index of variability is greater among full-bloods than among half-bloods. Yet, barring the greater number of marginal cases the distribution within the curve proper is more regular among full-bloods than among half-bloods.

Age and Growth. This diameter also shows a greater increase during the years 8 to 20 than the diameters of the head. The sexual differences are most marked after the sixteenth year. The full-bloods consistently have a higher face throughout.

Height of Face: Anatomical.

(Nasion to Chin).

Comparability of Results. The averages for different observers show very marked differences indicating a considerable difference in technique. Smith and Cooke have evidently selected a low point for

TABLE XLVI.

CEPHALO-FACIAL INDEX: DISTRIBUTION.

	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
76	1	.2						
7	0	.0						
8	0	.0						
9	0	.0						
80	1	.2						
1	0	.0						
2	0	.0						
3	0	.0						
4	0	.0	2	2.6				
5	0	.0	1	1.3				
6	2	.4	1	1.3				
7	1	.2	1	1.3	1	.6		
8	1	.2	2	2.6	5	3.2		
9	2	.4	2	2.6	2	1.3	2	10.6
90	11	2.0	3	3.9	7	4.5	2	10.6
1	16	3.0	11	14.3	6	3.7	1	5.3
2	36	6.7	10	13.0	15	9.6	2	10.6
3	32	6.0	10	13.0	19	12.2	7	37.0
4	62	11.6	10	13.0	20	12.8	3	15.8
5	45	8.4	10	13.0	24	15.4	1	5.3
6	76	14.2	6	7.8	13	8.3	1	5.3
7	83	15.5	2	2.6	21	13.4		
8	45	8.4	3	3.9	4	2.5		
9	57	10.6	2	2.6	6	3.8		
100	20	3.7	1	1.3	2	1.3		
1	27	5.0			8	5.1		
2	9	1.7			2	1.3		
3	7	1.3			0	.0		
4	0	.0			0	.0		
5	1	.2			1	.6		
6	0	.0						
7	0	.0						
8	0	.0						
9	0	.0						
110	1	.2						
Average	96.1		92.9		94.7		92.5	
σ	±3.22		±3.23		±3.22		±1.88	
e	± .14		± .37		± .26		± .43	
V in %	3.35		3.48		3.40			
No. of cases	536		77		156		19	

TABLE XLVII.

Cephalo-Facial Index: Growth.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	83.0									1	81.0								
5						1	77.0				2	85.0	4.0			1	81.0			
6	3	82.3	–.7	2.06	1.19	4	83.5	6.5	3.50	1.75	4	83.8	–1.2			2	83.5	2.5		
7	6	84.7	2.4	2.74	1.12	6	84.0	.5	3.65	1.44	5	85.0	1.2	2.20	.94	8	82.6	–.9	2.76	.98
8	11	84.8	.1	2.98	.87	2	82.0	–2.0			7	86.0	1.0	3.87	1.09	11	84.5	1.9	3.35	1.00
9	8	87.6	2.8	2.93	1.04	4	86.8	4.8			4	85.8	–.2			7	85.3	.8	2.71	1.03
10	13	86.5	–1.1	3.91	1.08	12	85.6	–1.2	2.81	.82	10	87.1	1.3	3.67	1.16	11	87.6	2.3	2.28	.69
11	13	86.9	.4	2.64	.73	11	86.3	.7	2.22	.67	3	88.3	1.2			3	86.7	–.9		
12	11	86.6	–.3	3.98	1.19	8	88.9	2.6	2.20	.78	14	89.4	1.1	2.54	.68	8	90.2	3.5	2.11	.74
13	15	89.9	3.3	3.47	.90	10	90.4	1.5	4.18	1.32	14	90.1	.7	3.23	.86	10	89.1	1.1	1.92	.61
14	14	89.2	–.7	3.76	1.01	12	89.8	–.6	2.15	.62	19	92.0	.9	2.94	.67	8	89.6	.5	3.16	1.12
15	15	89.7	.5	3.59	.92	6	90.2	.4	.90	.37	10	93.1	1.1	3.45	1.09	10	88.4	–1.2	2.15	.68
16	18	91.4	1.7	3.34	.78	11	91.0	.8	2.59	.78	10	94.2	1.1	2.60	.85	13	91.1	2.7	2.56	.71
17	19	92.8	1.4	2.50	.57	6	94.0	3.0	4.16	1.69	18	92.3	–1.9	2.66	.63	15	91.7	.6	2.44	.63
18	20	93.8	1.0	3.27	.73	4	92.8	–1.2			13	95.0	2.7	3.16	.88	12	91.0	–.7	1.92	.56
19	21	94.3	.5	2.61	.57	9	92.7	–.1	2.82	.94	16	93.1	–1.9	2.96	.74	3	95.7	4.7		
20+	536	96.1	1.8	3.35	.14	77	92.9	.2	3.23	.37	156	94.7	1.6	3.22	.26	19	92.5	–3.2	1.88	.43
60+	54	96.9	.8	2.92	.40						24	93.9	–.8	2.94	.59					

TABLE XLVIII.

Height of Face (Hairline to Chin): Averages for Different Observers

Observers	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	188.3	18	185.7	30	177.3	7	175.8
G. A Kaven	236	190.2	23	186.3	82	179.8	5	169.2
F. Boas	34	190.6	8	187.0	3	185.7	2	178.0
C. A. Helvin and F. C Kenyon	9	195.5	6	188.3	3	185.7	2	174.0
G M West					1	178.0	1	170.0
Average	330	189.9	55	186.4	119	179.4	17	173.6

the nasion while Kaven has selected a higher point. On the whole this diameter seems to be one of the most variable recorded, a part of which at least is due to the difficult technique involved. However, the difference does not seem of sufficient size to warrant correction, but it should be kept in mind that the average is probably not the true average. Since the results of each observer seem to be fairly consistent for all four groups the general results will not be seriously affected.

Sex and Blood. The sex difference for full-bloods is 7.2 mm. and 7.4 mm. for half-bloods. The half-blood males are relatively more variable than the full-bloods and the distribution is more irregular. The full-bloods in both sexes have the higher anatomical faces.

Age and Growth. The growth of this diameter brings out more clearly the differences due to sex and blood. The four curves of growth are quite widely separated throughout.

Height of Face: Upper
(Nasion to Chin).

The following averages of upper face height show the same differences for sex and blood that we have already found for the physiognomic and anatomic face heights.

	No.	Average	σ	e
Pure Sioux Male	43	81.1	±5.77	± .88
Half-blood Male	13	78.5	±4.79	±1.33
Pure Sioux Female	6	77.3	±2.86	±1.16
Half-blood Female	4	71.2	±4.71	±2.36

TABLE XLIX.

HEIGHT OF FACE (HAIRLINE TO CHIN): DISTRIBUTION.

Mm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No	Percent	No.	Percent
158					2	1.7	1	5.9
160					0	.0	0	.0
2					1	.8	0	.0
4					2	1.7	1	5.9
6					4	3.3	0	.0
8	2	.6			6	5.0	1	5.9
170	3	.9			5	4.2	3	17.6
2	6	1.8	3	5.4	5	4.2	1	5.9
4	6	1.8	4	7.2	11	9.3	2	11.8
6	9	2.7	2	3.6	12	10.1	4	23.5
8	14	4.2	1	1.8	14	11.8	2	11.8
180	18	5.5	5	9.1	11	9.3	1	5.9
2	16	4.8	2	3.6	10	8.4	1	5.9
4	21	6.4	4	7.2	8	6.7		
6	27	8.2	9	16.4	7	5.9		
8	25	7.6	5	9.1	7	5.9		
190	31	9.4	6	10.9	5	4.2		
2	36	11.0	5	9.1	5	4.2		
4	29	8.8	3	5.4	2	1.7		
6	25	7.6	3	5.4	1	.8		
8	25	7.6	2	3.6	1	.8		
200	14	4.2	0	.0				
2	12	3.6	1	1.8				
4	1	.3						
6	3	.9						
8	2	.6						
210	3	.9						
12	1	.3						
14	1	.3						
Average	189.9		186.4		179.4		173.6	
σ	±8.32		±7.27		±8.12		±5.65	
e	± .45		± .98		± .74		±1.37	
V in %	4.32		3.90		4.52		3.25	
No. of cases	330		55		119		17	

TABLE L.

Height of Face (Hairline to Chin): Growth.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	149.0									1	144.0								
5																1	152.0			
6	3	146.6	-2.4			2	153.5				1	139.0	-5.0			1	147.0	-5.0		
7	4	154.7	8.1			4	151.8	-1.7			3	158.9	19.9			5	154.4	7.4		
8	2	162.0	7.3			1	147.0	-4.8			3	151.7	-7.2			7	154.4	.0		
9	5	158.6	-3.4			3	153.7	5.7			2	147.0	-4.7			3	150.3	-4.1		
10	6	157.7	-.9			6	165.3	11.6			4	158.0	11.0			7	156.7	6.4		
11	8	162.4	4.7			7	163.1	-2.2			1	148.0	-10.0			3	155.3	-1.4		
12	2	173.0	10.6			5	166.2	3.1			8	167.2	19.2			7	171.2	15.9		
13	7	176.0	3.0			5	168.8	2.6			5	169.8	2.6			6	170.1	-1.1		
14	7	176.4	.4			9	178.0	9.2			9	173.9	4.1			5	173.6	3.5		
15	6	177.3	.9			5	176.8	-1.2			3	179.0	5.1			8	176.7	3.1		
16	6	180.8	3.5			7	181.9	5.1			5	180.0	1.0			9	178.8	2.1		
17	10	179.9	-.9			5	179.2	-2.7			11	181.2	1.2			14	174.5	-4.3		
18	11	189.6	9.7			4	179.0	-.2			8	174.2	-7.0			8	175.8	1.3		
19	16	188.0	-1.6			7	186.4	7.4			14	179.4	5.2			3	168.0	-7.8		
20+	330	189.9	1.9			55	186.4	.0			119	179.4	.0			17	173.6	4.6		
60+	39	191.2	1.3								15	176.4	-3.0							

TABLE LI.

HEIGHT OF FACE (NASION TO CHIN): AVERAGES FOR DIFFERENT OBSERVERS

Observers	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	120.9	18	118.9	30	113.5	7	113.3
J. W. Cooke	172	123.8	14	121.4	33	115.2	2	114.5
G. A Kaven	241	125.9	26	121.9	82	119.7	5	116.6
Z. T. Daniels	12	127.2	5	122.2	2	116.0		
F. Boas	34	125.3	8	124.7	3	119.0	2	114.5
C. A. Helvin and F. C. Kenyon	9	122.1	6	120.7	3	120.0	2	113.0
E. F. Wilson	18	122.7			3	113.7		
G M. West					1	116.0	1	118.0
Total Series	537	124.6	77	121.5	157	117.4	19	114.1

FACIAL INDEX: ANATOMICAL.

Comparability of Results. The differences in this index in the series of different observers are very similar to the differences in the height of the face previously mentioned.

Sex and Blood. The females have somewhat lower faces. The half-blood males have relatively slightly higher faces than the full-bloods. There is a greater difference between the width of face in full-bloods and half-bloods than in the height of the face. The half-blood males are more variable than the full-bloods. On the whole, this index is extremely variable and unsatisfactory for showing the differences between the full-bloods and half-bloods. It is very evident from the absolute measurements that one of the most marked differences between full-bloods, half-bloods, and whites is the more massive face of the former.[1] The full-blood has a much wider and higher face. The difference would be brought out more clearly by an average of these two diameters or the product of height and width of the face indicating the relative area of the face.

[1]Compare Boas, 1894–2 and 1895; also Jenks, 1916.

TABLE LII.

HEIGHT OF FACE (NASION TO CHIN): DISTRIBUTION.

Mm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
100					2	1.3		
2					2	1.3		
4					2	1.3	1	5.3
6			1	1.3	0	.0	0	.0
8	2	.4	1	1.3	7	4.5	1	5.3
110	7	1.3	1	1.3	17	10.8	2	10.6
12	11	2.0	2	2.6	14	8.9	5	26.4
14	13	2.4	10	13.0	16	10.2	2	10.6
16	38	7.1	3	3.9	13	8.3	4	21.0
18	32	6.0	9	11.6	21	13.4	2	10.6
120	68	12.7	15	19.5	19	12.1	1	5.3
2	68	12.7	9	11.6	19	12.1	1	5.3
4	86	16.0	8	10.4	9	5.7		
6	41	7.6	2	2.6	9	5.7		
8	40	7.5	7	9.1	6	3.8		
130	60	11.2	4	5.2	1	.6		
2	23	4.3	2	2.6				
4	24	4.5	1	1.3				
6	12	2.2	1	1.3				
8	5	.9	0	.0				
140	3	.6	1	1.3				
2	1	.2						
4	1	.2						
6	0	.0						
8	1	.2						
150	0	.0						
2	1	.2						
Average	124.6		121.5		117.4		114.1	
σ	±6.39		±6.36		±6.18		±4.12	
e	± .27		± .72		± .49		± .94	
V in %	5.12		5.23		5.26		3.61	
No. of cases	537		77		157		19	

Mixed Indian

Average 7 men 121.0 3 women 118.7

TABLE LIII.

Height of Face (Nasion to Chin): Growth.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc	σ	e	No.	Aver.	Inc.	σ	e
4	1	91.0				1					1	85.0								
5						1	93.0				2	98.0	13.0			1	96.0			
6	3	88.3	−2.7			4	91.5	−1.5			4	97.7	−.3			2	92.5	−3.5		
7	6	97.5	11.2			5	97.0	5.5			5	99.0	1.3			8	94.5	2.0		
8	4	104.0	6.5			2	99.5	2.5			7	97.5	−1.5			11	96.8	2.3		
9	13	104.0	.0	4.69	1.30	4	98.8	−.7			4	101.0	4.5			7	95.3	−1.5		
10	13	104.1	.1	3.70	1.03	12	112.6	13.8			10	99.5	−1.5	4.88	1.54	11	98.1	2.8		
11	13	104.2	.1	3.73	1.04	11	103.9	−8.7			2	103.5	4.0			3	103.6	5.5		
12	11	109.0	4.8	2.80	.84	7	106.1	2.2			14	108.8	5.3	4.55	1.21	8	105.0	1.4	6.46	2.28
13	15	111.0	2.0	5.09	1.32	8	107.8	1.7			12	108.4	−.4	4.59	1.32	10	105.5	.5	6.10	1.93
14	14	114.4	3.4	4.64	1.24	10	113.6	5.8			17	112.7	4.3	5.77	1.40	8	109.4	3.9	4.55	1.61
15	15	118.0	3.6	8.41	2.17	5	116.8	3.2			8	115.8	3.1	4.57	1.61	10	112.5	3.1	5.14	1.62
16	18	120.4	2.4	5.09	1.20	10	114.1	−2.7			10	115.4	−.4	4.72	1.48	13	111.2	−1.3	6.03	1.67
17	19	120.7	.3	5.71	1.31	6	116.8	2.7			18	116.6	1.2	6.04	1.42	15	110.9	−.3	4.25	1.09
18	19	124.3	3.6	4.85	1.11	4	114.5	−2.3			12	115.6	−1.0	5.85	1.68	12	111.5	.6	6.18	1.78
19	21	127.2	2.9	5,60	1.22	9	123.3	8.8			16	116.9	1.3	6.51	1.62	3	113.6	2.1		
20+	537	124.6	−2.6	6.39	.27	77	121.5	−1.8	6.36	.72	157	117.4	−2.3	6.18	.49	19	114.1	.5	4.12	.94
60+	54	125.1	.5	8.14	1.11						24	115.5	.9	6.93	1.42					

TABLE LIV.

FACIAL INDEX (ANATOMICAL): AVERAGE FOR DIFFERENT OBSERVERS.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C Smith	51	80.5	18	81.7	30	79.5	7	80.0
J. W. Cooke	170	82.1	14	83.2	33	80.1	2	83.0
G. A. Kaven	241	84.8	26	86.0	82	84.0	5	84.4
Z. T. Daniels	12	86.1	5	90.2	2	83.0		
F. Boas	33	84.7	8	87.4	3	84.6	2	84.0
C. A. Helvin and F. C. Kenyon	9	83.8	6	85.3	3	81.7	2	81.0
E. F Wilson	18	85.2			3	85.6		
G. M. West					1	80.0	1	84.0
Total Series	534	83.6	77	84.8	157	82.3	19	82.2

TABLE LV.

FACIAL INDEX (ANATOMICAL): DISTRIBUTION.

Mm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
68	1	.2						
70	0	.0			1	.6		
2	4	.7			2	1.3	1	5.3
4	19	3.5	2	2.6	7	4.4	0	.0
6	36	6.7	3	3.9	12	7.6	0	.0
8	42	7.9	4	5.2	20	12.8	2	10.6
80	74	13.8	14	18.2	26	16.6	3	15.8
2	83	15.6	11	14.3	26	16.6	6	31.6
4	97	18.2	10	13.0	27	17.2	4	21.0
6	69	12.9	8	10.4	18	11.4	3	15.8
8	53	10.0	7	9.1	9	5.7		
90	27	5.1	10	13.0	5	3.2		
2	13	2.4	4	5.2	2	1.3		
4	8	1.5	2	2.6	2	1.3		
6	5	.9	1	1.3				
8	2	.4	0	.0				
100	1	.2	0	.0				
2			1	1.3				
Average	83.6		84.8		82.3		82.2	
σ	±4.84		±5.28		±4.40		±3.27	
e	± .21		± .60		± .35		± .75	
V in %	5.78		6.22		5.35		3.97	
No. of cases	534		77		157		19	

Mixed Indian

Average for 7 men 78.2 3 women 84.0

TABLE LVI.

FACIAL INDEX (ANATOMICAL): GROWTH.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	75.0									1	76.0								
5						1	86.0				2	81.5	5.5			1	80.0			
6	3	73.7	-1.3			4	77.0	-9.0			4	81.2	-.3			2	79.0	-1.0		
7	6	80.0	-6.3			5	80.2	3.2			4	78.5	-2.7			8	80.9	1.9		
8	4	83.3	3.3			2	84.0	3.8			7	78.3	.8			11	78.8	-2.1		
9	13	82.2	-1.1	4.72	1.31	3	79.3	-4.7			4	81.5	2.2			7	78.1	-.7		
10	13	82.3	.1	3.99	1.11	12	83.7	4.4			10	79.2	-2.3	1.12	.35	11	79.3	1.2		
11	13	81.8	-.5	3.39	.94	11	83.4	-.3			2	82.5	3.3			3	82.6	3.3		
12	11	83.4	1.6	3.85	1.16	7	80.0	-3.4			14	82.4	-.1	3.84	1.02	8	79.5	-3.1	4.87	1.72
13	15	83.3	-.1	3.38	.87	8	81.2	1.2			12	81.2	-1.2	3.28	1.02	10	79.7	.2	5.12	1.61
14	14	85.4	2.1	3.42	.91	10	85.7	4.5			18	83.1	1.9	3.63	.85	8	83.0	3.3	4.21	1.48
15	15	86.5	1.1	5.87	1.51	5	86.8	1.1			8	83.6	.5	2.34	.82	10	83.5	.5	4.20	1.32
16	18	87.1	.6	4.84	1.14	10	81.0	-5.8			10	82.7	-.9	3.87	1.22	13	81.6	-1.9	4.02	1.11
17	19	86.1	-1.0	4.70	1.07	6	82.0	1.0			18	84.6	1.9	5.79	1.36	15	81.4	-.2	2.60	.67
18	19	86.7	.6	4.01	.92	4	81.2	-.8			12	81.0	-3.6	4.86	1.40	12	82.5	1.1	3.86	1.11
19	21	87.8	1.1	4.54	.99	9	87.9	6.7			16	83.9	2.9	5.98	1.50	3	80.6	-1.9		
20+	534	83.6	-4.2	4.84	.21	77	84.8	-3.1	5.28	.60	157	82.3	-1.6	4.40	.35	19	82.2	1.6	3.27	.75
60+	54	83.0	- 6	5.71	.78						24	81.8	-.5	5.36	1.09					

TABLE LVII.

Height of Nose: Average for Different Observers.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	55.9	18	54.4	30	53.3	7	51.9
J. W. Cooke	174	57.4	14	55.9	33	55.2	2	52.5
G. A. Kaven	241	59.8	26	56.0	82	56.2	5	53.2
Z. T. Daniels	12	56.8	5	53.0	2	52.5		
F. Boas	34	57.0	8	53.8	3	54.7	2	50.0
C. A. Helvin and F. C. Kenyon	9	54.6	6	52.8	3	54.7	2	47.5
E. F. Wilson	18	58.6			3	51.4		
G. M. West					1	49.0	1	49.0
Total Series	539	58.3	77	54.9	157	55.2	19	51.5

TABLE LVIII.

Nose Height: Distribution.

Mm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
46	2	.4			1	.6	1	5.3
8	4	.8	6	7.8	6	3.8	5	26.4
50	11	2.0	11	14.2	18	11.4	5	26.4
2	41	7.6	12	15.6	21	13.4	2	10.6
4	82	15.2	12	15.6	37	23.5	5	26.4
6	97	18.1	18	23.4	32	20.5	0	.0
8	73	13.6	10	13.0	28	17.8	1	5.3
60	121	22.5	6	7.8	12	7.7		
2	54	10.0	2	2.6	2	1.3		
4	38	7.1						
6	12	2.2						
8	1	.2						
70	3	.6						
Average	58.3		54.9		55.2		51.5	
σ	± 3.94		± 3.55		± 3.51		± 2.95	
e	$\pm .17$		$\pm .40$		$\pm .28$		$\pm .68$	
V in %	6.75		6.48		6.35		5.73	
No. of cases	539		77		157		19	

Mixed Indian

Average for 7 men 56.4 3 women 53.7

TABLE LIX.

NOSE HEIGHT: GROWTH.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	40.0									1	39.0								
5						1	37.0				2	38.5	-.5			1	47.0			
6	3	37.0	-3.0			4	37.2	.2			4	43.5	5.0			2	37.0	-10.0		
7	6	41.5	4.5			5	40.8	3.6			5	44.0	.5			8	37.5	-.5		
8	4	45.0	3.5			2	39.0	-1.8			7	42.3	-1.7			11	41.1	3.6		
9	13	45.3	.3	3.68	1.02	4	43.0	4.0			4	44.5	2.2			7	41.0	.0		
10	13	45.6	.3	4.06	1.12	12	44.2	1.2			10	45.1	.6	3.78	1.19	11	42.6	1.6		
11	13	45.6	.0	2.23	.61	11	45.7	1.5			2	46.0	.9			4	43.8	1.2		
12	11	44.9	-.7	2.81	.84	7	47.4	1.7			14	47.8	1.8	4.60	1.23	8	44.6	.8	3.77	1.33
13	15	50.8	5.9	3.51	.91	8	46.1	-1.3			12	47.0	-.8	4.51	1.30	10	46.6	2.0	3.17	1.00
14	14	50.6	-.2	2.96	.79	10	49.3	3.2			18	50.6	3.6	4.13	.97	8	46.2	-.4	3.46	1.22
15	15	52.2	1.6	3.45	.89	5	54.2	4.9			8	52.0	1.4	2.83	1.00	10	49.8	3.6	2.78	.88
16	18	53.8	1.6	4.31	1.01	10	47.5	3.3			10	51.8	-.2	3.06	.97	13	48.8	-1.0	3.26	.90
17	19	54.6	.8	3.56	.81	6	47.0	-.5			18	52.0	.2	4.23	.99	15	49.6	.8	3.65	.94
18	20	55.8	1.2	3.30	.73	4	49.2	2.2			11	51.7	-.3	3.32	1.00	12	47.9	-1.7	3.64	1.05
19	21	57.4	1.6	3.33	.72	9	54.1	4.9			16	52.6	.9	3.38	.84	3	52.0	4.1		
20+	539	58.3	.9	3.94	.17	77	54.9	.8	3.55	.40	157	55.2	2.6	3.51	.28	19	51.5	-.5	2.95	.68
60+	55	60.6	2.3	4.22	.57						24	57.3	2.1	3.89	.79					

Age and Growth. The curves of growth are rather irregular but bring out quite clearly the sexual differences in this index. The females consistently have lower faces. The general tendency is for this index to increase during the period of growth, indicating a greater increase in height than in width of the face.

Nose Height.

Comparability of Results. The same differences are noticeable here that were conspicuous in the anatomical face height. Smith's and Cooke's averages are low and Kaven's average is high throughout.

Sex and Blood. The same differences are found here that we noticed in the measurements of height of the face. The noses of the females are 3.1 mm. shorter on the average among full-bloods and 3.4 mm. shorter among half-bloods. The full-bloods have the higher noses in both sexes. This diameter is very variable. This again is undoubtedly partly due to differences in technique. The full-bloods are more variable in both sexes.

Growth and Age. The sexual and racial differences are clearly brought out in the curves of growth. All four groups show a considerable increase in this diameter during the period from the eighth to the twentieth year.

Nose Width.

Comparability of Results. There is a very close agreement in the averages of the different observers.

Sex and Blood. The males have the wider noses. The sexual difference is 2.5 mm. for full-bloods and 2.8 mm. for half-bloods. The full-bloods have the wider noses. The half-bloods are less variable as measured by the coefficient of variation, but the distribution is more regular in the case of the full-bloods.

Age and Growth. This diameter does not increase as much as the diameter of height. The full-bloods have the wider noses for almost every year. Sex differences are quite marked after the fourteenth year. The old individuals over 60 years seem to have wider noses. Whether this is accidental or actual is difficult to say. It is possible that a lack of muscle toneness causes an increase in this diameter in old age.

TABLE LX.

Width of Nose: Averages for Different Observers.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	40.3	18	38.8	30	38.5	7	34.6
J. W. Cooke	175	39.5	14	35.1	33	37.7	2	33.0
G. A. Kaven	241	40.3	26	37.9	82	37.1	5	34.6
Z. T. Daniels	12	41.4	5	39.6	2	38.0		
F. Boas	34	38.0	8	36.6	3	36.0	2	35.5
C. A. Helvin and F C. Kenyon	9	39.3	6	38.0	3	36.7	2	37.5
E. F. Wilson	18	41.0			3	36.7		
G. M. West					1	32.0	1	35.0
Total Series	540	39.9	77	37.6	157	37.4	19	34.8

TABLE LXI.

Nose Width: Distribution.

Mm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
30			1	1.3				
2	10	1.9	4	5.2	13	8.3	7	36.4
4	33	6.1	15	19.4	27	17.2	4	21.0
6	81	15.0	21	27.3	43	27.5	5	26.3
8	116	21.5	15	19.4	42	26.7	3	15.8
40	151	27.0	13	17.0	20	12.8		
2	73	13.6	6	7.8	8	5.1		
4	47	8.7	1	1.3	2	1.3		
6	20	3.7	1	1.3	1	.6		
8	8	1.5			1	.6		
50	1	.2						
Average	39.9		37.6		37.4		34.8	
σ	±3.22		±3.04		±2.91		±2.27	
e	± .14		± .35		± .23		± .52	
V in %	8.07		8.08		7.77		6.52	
No. of cases	540		77		157		19	

Mixed Indian

Average for 7 men 40.6 3 women 36.3

TABLE LXII.

NOSE WIDTH: GROWTH.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc	σ	e	No.	Aver.	Inc.	σ	e
4	1	33.0									1	27.0								
5						1	32.0				2	31.5	4.5			1	29.0			
6	3	31.0	-2.0			4	29.8	-2.2			4	30.2	-1.3			2	28.0	-1.0		
7	6	31.5	.5			5	30.8	1.0			5	30.4	.2			8	29.1	1.1		
8	4	31.8	.3			2	31.5	.7			6	32.0	1.6			11	31.2	2.1		
9	13	32.8	1.0	1.87	.51	4	31.2	-.3			4	31.0	-1.0			7	20.1	-1.1		
10	13	32.8	.0	2.47	.66	12	33.2	2.0			10	33.5	2.5	2.06	.65	11	31.2	1.1		
11	13	33.4	.6	1.86	.51	11	33.4	.2			2	32.0	-1.5			4	31.2	.0		
12	11	34.2	.8	2.85	.86	7	32.0	-1.4			14	33.1	1.1	2.19	.58	8	32.6	1.4	1.23	.43
13	15	36.1	1.9	3.32	.85	8	32.4	.4			12	33.7	.6	1.47	.42	10	33.7	1.1	1.73	.54
14	14	34.3	-1.8	3.53	.94	10	34.5	2.1			18	34.6	.9	2.33	.55	8	34.8	1.1	3.02	1.06
15	15	37.2	2.9	2.74	.71	5	35.0	.5			8	34.8	.2	2.11	.74	10	34.4	-.4	1.80	.56
16	18	37.3	.1	2.26	.53	10	34.9	-.1			10	34.4	-.4	2.15	.68	13	35.3	.9	2.43	.67
17	19	38.0	.7	3.88	.89	6	35.3	.4			18	35.2	.8	1.90	.44	15	34.3	-1.0	2.30	.60
18	20	36.4	-1.6	1.62	.36	4	37.8	2.5			12	35.5	.3	3.07	.88	12	33.6	-.7	1.70	.48
19	21	37.8	1.4	2.92	.63	9	36.3	-1.5			16	35.6	.1	2.59	.65	3	34.6	1.0		
20+	540	39.9	2.1	3.22	.14	77	37.6	1.3	3.04	.35	157	37.4	1.8	2.91	.23	19	34.8	.2	2.27	.52
60+	55	43.3	3.4	3.15	.44						24	40.2	2.8	2.44	.49					

Nasal Index.

Comparability of Results. The extreme variability of this index, due in part to differences in technique, will not allow us to make any generalizations unless we find very considerable differences in the averages.

TABLE LXIII.

Nasal Index: Average for Different Observers.

Observer	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
F. C. Smith	51	72.3	18	72.4	30	72.2	7	66.6
J. W. Cooke	171	69.1	14	65.2	33	69.1	2	63.5
G. A. Kaven	241	67.8	26	68.1	82	66.0	5	65.2
Z. T. Daniels	12	72.7	5	75.0	2	72.5		
F. Boas	34	66.9	8	68.2	3	63.7	2	70.5
C. A. Helvin and F. C. Kenyon	9	72.1	6	72.0	3	67.4	2	79.5
E. F. Wilson	18	70.7			3	72.6		
G. M. West					1	65.0	1	71.0
Total Series	536	68.8	77	69.2	157	68.0	19	67.8

Sex and Blood. As stated before, this index is very variable and our small differences are very uncertain. In general all we can say is that females have a slightly narrower nose as measured by the nasal index. All the groups are about equally variable. As in the instance of the face the racial differences seem to lie more in the actual diameters than in their relation to one another. The full-bloods have longer and wider noses than the half-bloods but the index is very similar.

Age and Growth. The excess of increase in height over increase in width causes a marked decrease in this index or a relative narrowing of the nose during the period of growth.

III. CORRELATION OF DIFFERENT MEASUREMENTS.

In order to decrease the amount of work involved in making out correlation tables we have determined the coefficient of correlation by means of the use of the coefficient of variability of two absolute diameters and the index indicating the relationship of these two measurements.

TABLE LXIV.

NASAL INDEX: DISTRIBUTION.

Mm.	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	Average	No.	Average	No.	Average	No.	Average
52	3	.6			1	.6		
4	6	1.1			0	.0		
6	13	2.4	2	2.6	4	2.6		
8	14	2.6	4	5.2	11	7.0	1	5.3
60	44	8.2	4	5.2	16	10.2	3	15.8
2	36	6.7	9	11.6	14	8.9	0	.0
4	57	10.6	7	9.1	15	9.6	5	26.4
6	75	14.0	7	9.1	17	10.8	2	10.6
8	65	12.2	10	13.0	15	9.6	1	5.3
70	55	8.4	7	9.1	19	12.0	1	5.3
2	57	10.6	8	10.4	12	7.7	2	10.6
4	33	6.2	1	1.3	13	8.3	1	5.3
6	25	4.7	5	6.5	4	2.6	2	10.6
8	15	2.8	5	6.5	6	3.8	0	.0
80	17	3.2	5	6.5	4	2.6	0	.0
2	11	2.0	1	1.3	2	1.3	1	5.3
4	13	2.4	1	1.3	1	.6		
6	3	.6	1	1.3	3	1.9		
8	2	.4						
90	2	.4						
Average	68.8		69.2		68.0		67.8	
σ	$\pm$7.05		$\pm$7.08		$\pm$7.09		$\pm$6.42	
e	$\pm$ .30		$\pm$ .81		$\pm$ .57		$\pm$1.47	
V in %	10.25		10.23		10.42		9.47	
No. of cases	536		77		157		19	

	Mixed Indian
Average for 7 men	72.0

When Vi= the coefficient of variability of a given index, Va= the coefficient of variability of one dimension and Vb equals the coefficient of variability of the second dimension then

$$Vi^2 = Va^2 + Vb^2 - 2rVaVb$$

$$\text{or} - r = \frac{Vi^2 - Va^2 - Vb^2}{2\,(VaVb)}$$

TABLE LXV.

NASAL INDEX: GROWTH.

Age	Male										Female									
	Pure Sioux					Half-bloods					Pure Sioux					Half-bloods				
	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e	No.	Aver.	Inc.	σ	e
4	1	82.0									1	69.0								
5						1	86.0				2	82.0	13.0			1	62.0			
6	3	84.3	2.3			4	80.2	–5.8			4	70.8	–11.2			2	72.5	10.5		
7	6	76.0	–8.3			6	75.5	–4.7			5	69.6	–1.2			8	78.1	5.6	10.89	3.84
8	5	73.4	–2.6			2	74.0	–1.5			7	75.1	5.5	7.49	2.83	11	76.7	1.4	8.89	2.67
9	13	72.8	–.6	8.32	2.31	4	76.5	2.5			4	70.2	–4.9			7	74.3	–2.4	9.11	3.45
10	13	73.5	.7	8.67	2.40	12	75.3	–1.2	7.39	2.22	10	74.7	4.5	6.20	1.96	11	73.9	–.4	5.30	1.59
11	13	73.4	–.1	5.40	1.50	11	73.5	–1.8	5.93	1.78	3	70.0	–4.7			4	71.5	–2.4		
12	11	76.2	2.8	6.68	2.01	8	69.0	–4.5	6.40	2.40	14	69.7	–.3	7.17	1.91	8	73.1	1.6	5.67	2.01
13	15	71.3	–4.9	6.94	1.79	12	71.7	2.7	7.42	2.11	13	70.8	1.1	8.30	2.30	10	72.6	–.5	6.05	1.91
14	14	69.1	–2.2	10.37	2.77	12	68.4	–3.3	6.43	1.87	19	68.6	–2.2	7.26	1.66	8	75.5	2.9	8.82	3.11
15	17	71.4	2.3	6.23	1.51	6	65.0	–3.4			9	65.7	–2.9	4.72	1.57	10	69.3	–6.2	4.54	1.43
16	17	70.1	–1.3	7.87	1.91	11	73.9	8.9	7.71	2.32	11	66.9	1.2	5.85	1.76	13	72.8	3.5	7.30	2.02
17	19	69.9	–.2	8.10	1.85	6	71.3	–2.6			18	68.3	1.4	7.25	1.71	15	70.2	–2.6	6.56	1.69
18	20	65.4	–4.5	4.92	1.10	4	71.5	.2			13	69.2	.9	8.41	2.33	12	69.8	–.4	5.14	1.48
19	21	66.2	.8	6.05	1.32	9	67.4	–4.1	5.56	1.85	16	68.3	–.9	8.23	2.05	3	66.7	–3.1		
20+	536	68.8	2.6	7.05	.30	77	69.2	1.8	7.08	.81	157	68.0	–.3	7.09	.57	19	67.8	1.1	6.42	1.47
60+	55	71.8	3.0	6.58	.88						24	71.0	3.0	7.54	1.54					

Substituting in the above formula we obtained the coefficient of correlation for total stature and sitting height, stature and width of shoulders, stature and arm reach, stature and length of arm, length of head and width of head, width of head and width of face, width and height (anatomical) of face, width and height of nose. The results are listed in Table LXVI.

The highest degree of correlation exists between stature and arm reach. A very high degree of correlation also exists between length of arm and stature and sitting height and stature. The correlation between

TABLE LXVI.

CORRELATIONS.

Measurements	Male				Female			
	Pure Sioux		Half-bloods		Pure Sioux		Half-bloods	
	No.	r	No.	r	No.	r	No.	r
Stature and Sitting Height	536	.61	77	.65	157	.54		
Stature and Width of Shoulder	534	.35	77	.48	157	.43		
Stature and Arm Reach	531	.81	77	.85	157	.83		
Stature and Length of Arm	532	.70	77	.76	157	.67		
Length to Width of Head	538	.27	77	.54	156	.38		
Length to Width of Head[1]			126	.54	243	.31	82	.24
Width of Head and Width of Face	538	.55	77	.51	156	.49		
Width of Head and Width of Face[1]			126	.54	243	.52	82	.68
Height and Width of Face	534	.16	77	.08	157	.31		
Height and Width of Face[1]			126	.13	243	.20	82	.43
Height and Width of Nose	536	.05	77	.02	157	−.08		

stature and width of shoulder is somewhat less. Among the diameters of the head and face we find the highest correlation between the width of the head and the width of the face. There is a fair degree of correlation between width and length of head especially among the half-blood males. The face proportions do not show as high a degree of relationship as those of the head. Practically no correlation exists between the diameters of the nose. In some of the head and face measurements we have

[1]In these series the measurements of children have been changed into adult measurements by adding the average yearly increment times the number of years below twenty. Ages 15 to 19 inclusive have been so treated. The purpose was to increase the number of cases. Such procedure has not effected the correlation coefficient to any great extent.

added the proper correction to the measurements of children and considered them as adults. The purpose was to increase the number of cases. Apparently this has not seriously effected the coefficient of correlation since it resulted only in minor changes in the coefficient obtained when dealing with adults only.

As has been previously mentioned practically no correlation exists between stature and the cephalic index among full-blood males.

It had been expected that racial intermixture would effect the correlation of the various proportions of the head and body and that there would be marked differences between the pure Sioux and the half-bloods. On the whole the differences are rather small. Among the half-bloods the coefficients of correlation for stature and sitting height, stature and width of shoulder, stature and arm reach, stature and length of arm, and length and width of head are somewhat larger than the corresponding coefficients among full-bloods. On the other hand the coefficients of correlation for width and height of face, and width and height of nose are somewhat smaller.

It is perhaps significant that the decreased correlation in half-bloods is for the most part confined to those diameters in which the Indians and whites are most widely contrasted. The high degree of uniformity in the relationship of other dimensions would seem to indicate that there were no very marked differences in these proportions in the intermingling groups.

If we subdivide our series of full-bloods into its component bands we get marked differences in the coefficients of correlation of length of head and width of head. The coefficient ranges from –.09 to +.60. The number of cases in each series is very small and the error correspondingly large.

TABLE LXVII.

Correlation of Length and Width of Head Among Tribes and Local Groups.

Pure Sioux.

53	Sisseton	r = .30
52	Yankton	r = .44
72	Yanktonai	r = .15
66	Brulé	r =–.09
49	Oglala	r = .32
30	Blackfoot	r = .01
33	Two Kettle	r = .60
35	Hunkpapa	r = .33
40	Miscellaneous	r = .12
538	Total Series	r = .27

IV. THE INHERITANCE OF FACE WIDTH.

In view of the fact that the marked difference in face width is one of the most constant and characteristic differences between Indians and whites it seems to be important to study in more detail the behavior of this characteristic in heredity and the condition found in the Indian-white offspring. Up to this point we have considered all our Indian-white individuals as half-bloods. For general averages this course is justified since the one-quarter Indians balance the three-quarter Indians in the series. In order to study the inheritance of face width it seems necessary to distinguish the following degrees of intermixture:—

1. One-fourth Indian = White × one-half Indian.
2. One-half Indian = White × full Indian.
3. Two-fourths Indian = One-half Indian × one-half Indian (second generation).
4. Three-fourths Indian = One-half Indian × full Indian.

But since we have only 77 male adults and 19 female adults in our mixed Indian-white series the division into four types would make some of our groups extremely small and of little value. Under these circumstances it seems advisable to reduce our entire series of children to adults and the females to males. Such a procedure will give us adult male series as follows:—

47	One-fourth Indian.
49	Two-fourths Indian.
169	One-half Indian.
63	Three-fourths Indian.
328	Total mixed Indian-white.

In order to convert our series of children into an adult series it is first necessary to smooth the irregular line of growth indicated by our small age groups. For this purpose we have employed the formula for a straight line.

$$o = a + bt =$$

in which $a = [o]$ and $b = \frac{[ot].}{[t^2]}$ All values were weighted by the number of cases (n).

But the face increases very considerably (nearly 3 cm.) in width during the period of growth covered by our series. It is evident that the rate of growth for each year is not the same and our line of growth is not a straight line but a composite line. For this reason we divided

our series of male children into three groups, the first of which contained the ages 5 to 10, the second ages 11 to 16, and the third ages 17 to 26. Individuals up to the age of 26 were included in the series because the face does not attain the adult proportions until about that time. The average yearly increment (b) for males, ages 5 to 10 years, was found to be 2.0 mm., ages 11 to 16 years, 2.6 mm., ages 17 to 26 years, 0.5 mm.

The series of girls was grouped as follows: ages 5 to 9, 10 to 15, 16 to 26. The average yearly increment for the ages 5 to 9 was found to be 2.5 mm., ages 10 to 15 years was 1.5 mm., and ages 16 to 26 years was 0.5 mm.

Our smoothed rate of growth and correction added to convert to adults follow:—

TABLE LXVIII.

THEORETICAL GROWTH OF FACE IN WIDTH.

Age	Male		Female	
	Face Width mm.	Adult Correction mm.	Face Width mm.	Adult Correction mm.
5	115.7	28.9	114.1	26.3
6	117.7	26.9	116.7	23.7
7	119.7	24.9	119.1	21.3
8	121.7	22.9	121.7	18.7
9	123.7	20.9	124.1	16.3
10	125.7	18.9	126.7	13.7
11	126.5	18.1	128.2	12.2
12	129.1	15.5	129.7	10.7
13	131.7	12.9	131.2	9.2
14	134.3	10.3	132.7	7.7
15	136.9	7.7	134.2	6.2
16	139.5	5.1	135.4	5.0
17	140.1	4.5	135.9	4.5
18	140.6	4.0	136.5	3.9
19	141.1	3.5	137.0	3.4
20	141.6	3.0	137.5	2.9
21	142.2	2.4	138.0	2.4
22	142.6	2.0	138.4	2.0
23	143.2	1.4	138.9	1.5
24	143.6	1.0	139.4	1.0
25	144.2	0.4	139.9	.5
26+	144.6	.0	140.4	.0

TABLE LXIX.

Width of Face: Indian-White Hybrids.

Face Width	1–4 Indian		2–4 Indian		1–2 Indian		2–4+1–2 Indian		3–4 Indian		Total Series	
mm.	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
128					1	.6	1	.5			1	.3
130	1	2.1			1	.6	1	.5	1	1.6	3	.9
132	1	2.1			4	2.3	4	1.8	1	1.6	6	1.8
134	0	0			1	.6	1	.5	0	.0	1	.3
136	4	8.5	3	6.1	9	5.3	12	5.5	1	1.6	17	5.2
138	4	8.5	4	8.1	13	7.7	17	7.7	7	1.1	28	8.5
140	6	12.7	5	10.2	22	13.0	27	12.3	4	16.3	37	11.3
142	8	17.0	10	20.4	24	14.2	34	15.6	9	4.3	51	15.5
144	5	10.6	7	14.3	15	8.8	22	10.1	8	12.7	35	10.7
146	4	8.5	4	8.1	31	18.3	35	16.1	12	19.0	51	15.5
148	4	8.5	4	8.1	25	14.9	29	13.3	7	11.1	40	12.2
150	5	10.6	7	14.3	10	6.0	17	7.7	6	9.5	28	8.5
152	3	6.3	1	2.0	6	3.5	7	3.2	3	4.7	13	3.9
154	1	2.1	3	6.1	1	.6	4	1.8	1	1.6	6	1.8
156	0	.0	1	2.0	4	2.3	5	2.3	1	1.6	6	1.8
158	1	2.1			2	1.2	2	.9	2	3.2	5	1.5
No. of Cases	47		49		169		218		63		328	
Average		144.0		144.94		144.37		144.59		145.25		144.49
σ		±5.88		±4.99		±5.31		±5.18		±5.43		±5.37
e		± .86		± .71		± .40		± .34		± .68		± .29

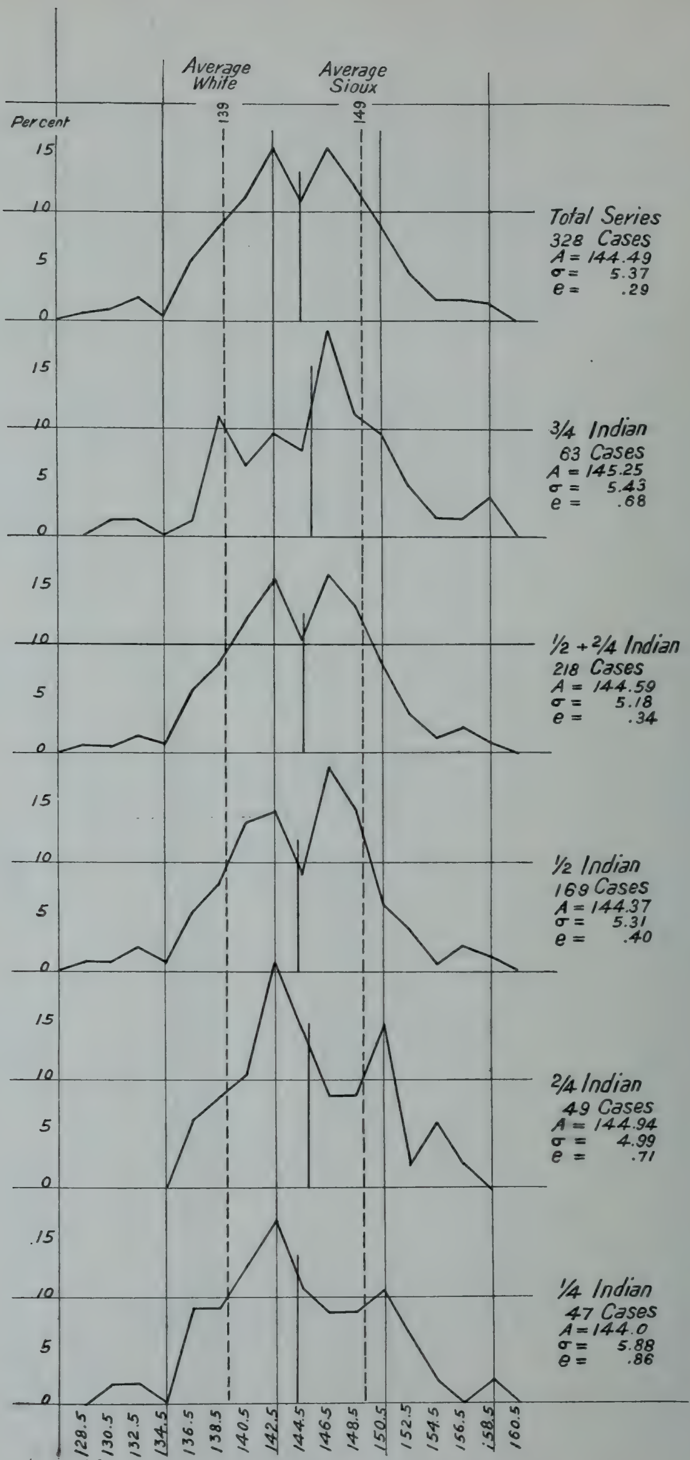

Fig. 1. Width of Face: Indian-White Series.

To each female was added 4.2 mm. to convert it to the male standard. The seriation, averages, and variability of the various groups are shown in Table LXIX and Fig. 1.

The average width of face for the converted series of 328 is slightly higher than the actual average of the 76 male half-bloods in Table XLIII. This difference, however, will not appreciably influence the distribution of this character.

In the table of distribution of face width of 76 adult male half-bloods (Table XLIII and Fig. 6) we noted a bimodal distribution. The average was 143.4 mm., and the modes were 140 and 148 mms. The average width of face of those European peoples with whom these Indians have mixed most (French, Scotch, English, Irish) is approximately 139 mms. In our series of full-blood Indians the average was 149 mms. and the mode 150 mms. While our Indian-white crosses have an average of 144.5 mms., intermediate between the Indian and white, the modes tend toward the averages of the whites and Indians respectively.

When we consider our reconstructed series we find similar results. In the one-fourth Indian the bimodal distribution is not as clear, nevertheless the tendency seems to be to form a major mode of 142 mm., and a minor mode of 150 mm. In the two-fourths Indians the distribution is very similar and the modes are the same as those of the one-fourth Indians. The curve is more clearly bimodal. The series of half-blood Indians has its modes at 142 and 146 mms. If we combine the two-fourths and one-half we get a distinctly bimodal distribution with modes of 142 and 146 mms. In the case of the three-fourths Indians the bimodal distribution is not as certain. The mode and average are very similar. If we re-combine the entire series again we still have a bimodal distribution. In every case except the three-fourths Indians the bimodal distribution is fairly clear. The average in all of these cases falls at a point of low frequency. From this it would seem that we are justified in concluding that face width is inherited in such a manner that either the Indian or white type of face is inherited. There is no tendency to form an intermediate type and in fact the intermediate type of face is of rare occurrence.

We have also noticed that the ratio of face width to head width was considerably different in full-bloods and half-bloods. The full-bloods had absolutely and relatively much wider faces than the half-bloods. However, the distribution of this ratio, expressed by the cephalo-facial index in Table XLVI and Fig. 7, was fairly symmetrical. This can be explained only by the fact that there is a fairly high degree of

TABLE LXX.

Average Width of Head Associated with a Given Width of Face.

Width of Face	1–4 Indian		2–4 Indian		1–2 Indian		2–4+1–2 Indian		3–4 Indian		Total Series	
	No. of Cases	Average Width of Head	No. of Cases	Average Width of Head	No. of Cases	Average Width of Head	No. of Cases	Average Width of Head	No. of Cases	Average Width of Head	No. of Cases	Average Width of Head
128					1	146.5	1	146.5			1	146.5
130	1	150.5			1	150.5	1	150.5	1	140.5	3	147.1
132	1	156.5			3	141.8	3	141.8	1	146.5	5	145.7
134					1	146.5	1	146.5			1	146.5
136	4	153.0	3	148.5	9	151.8	12	151.0	1	146.5	17	151.2
138	4	151.5	4	153.0	13	151.6	17	151.9	7	149.1	28	151.4
140	6	151.5	5	152.1	22	151.5	27	151.6	4	153.5	37	151.8
142	8	157.3	10	151.5	24	152.9	34	152.5	9	154.1	51	153.5
144	5	153.5	7	152.5	15	154.1	22	153.6	8	154.7	35	153.8
146	4	153.5	4	154.0	31	153.5	35	153.5	12	155.3	51	153.9
148	4	157.5	4	154.5	25	158.1	29	156.6	7	155.9	40	156.5
150	5	157.7	7	157.5	10	158.9	17	158.5	6	157.8	28	158.1
152	3	161.8	1	158.5	6	159.5	7	159.4	3	158.5	13	159.7
154	1	156.5	3	158.5	1	154.5	4	156.5	1	160.5	6	157.8
156	1	156.5	1	164.5	4	159.0	5	160.1	1	152.5	7	158.5
158					2	163.5	2	162.5	2	159.5	4	161.5
Total Cases	47		49		168		217		63		327	
Average Width of Head		155.1		153.8		153.9		153.9		154.5		154.2
Average Width of Face		144.0		145.1		144.5		144.6		145.3		144.6

correlation between width of head and width of face which is not disturbed by intermixture. That some such relationship exists may be seen by obtaining the average width of head[1] for a given width of face. This has been done in Table LXX. In spite of the small number of cases we get a rather regular progression of head width with an increase in face width.

This relationship may be more accurately expressed by means of the coefficients of correlation and coefficients of regression. These are given in Table LXXI. It will be seen that there is a fairly high degree of correlation (.55) in the full Indians. This correlation seems on the whole to be increased in the mixed-bloods.

TABLE LXXI.

Face Width and Head Width: Correlation and Regression.

	1–4 Indian	2–4 Indian	1–2 Indian	2–4+ 1–2 Indian	3–4 Indian	Total Indian White	Full Indian
Number of cases	47	49	168	217	63	327	536
Coefficient of Correlation (r)	.53	.58	.60	.59	.72	.58	.55
Regression of Width of Face on Width of Head (px)	.78	.58	.65	.64	.86	.66	.54
Regression of Width of Head on Width of Face (py)	.36	.58	.55	.55	.60	.51	.56

By means of the coefficient of regression we can determine the average width of face for a given width of head in our series. These averages are listed in Table LXXII.

From this and the preceding tables it seems that those individuals with a narrow head tend to inherit the European type of face while those with wide heads tend to inherit the Indian type of face. A similar tendency was demonstrated by Professor Boas[2] in a much larger series.

We can test this conclusion further by reducing the width of face of the entire series to the standard of the average width of head. This can be done by use of the coefficient of regression. Suppose, for example, that the coefficient of regression of width of face on width of head is 0.7

[1]Head width was also converted to the adult male standard.
[2]Boas, 1895. (The present series was included in 1895 series).

TABLE LXXII.

AVERAGE WIDTH OF FACE ASSOCIATED WITH A GIVEN WIDTH OF HEAD.

	1–4 Indian	2–4 Indian	1–2 Indian	1–2 +3–4 Indian	3–4 Indian	Total Mixed Bloods	Full Indian
Coefficient of Regression	.78	.58	.65	.64	.86	.66	.54
Width of Head							
138	130.76	135.94	134.16	134.42	131.20	133.91	139.87
9	131.54	136.52	134.81	135.66	132.06	134.57	140.41
140	132.32	137.10	135.46	135.70	132.92	135.23	140.95
1	133.10	137.68	136.11	136.34	133.78	135.89	141.49
2	133.88	138.26	136.76	136.98	134.64	136.55	142.03
3	134.66	138.84	137.41	137.62	135.50	137.21	142.57
4	135.44	139.42	138.06	138.26	136.36	137.87	143.11
5	136.22	140.00	138.71	138.90	137.22	138.53	143.65
6	136.90	140.58	139.36	139.54	138.08	139.19	144.19
7	137.68	141.16	140.01	140.18	138.94	139.85	144.73
8	138.46	141.74	140.66	140.82	139.80	140.51	145.27
9	139.24	142.32	141.31	141.46	140.66	141.17	145.81
150	140.02	142.90	141.96	142.10	141.52	141.83	146.35
1	140.80	143.48	142.61	142.74	142.38	142.49	146.89
2	141.58	144.06	143.26	143.38	143.24	143.15	147.43
3	142.36	144.64	143.92	144.02	144.10	143.81	147.97
4	143.14	145.22	144.56	144.66	144.96	144.47	148.51
5	143.92	145.80	145.22	145.30	145.82	145.13	149.05
6	144.70	146.38	145.87	145.94	146.68	145.79	149.59
7	145.48	146.96	146.52	146.58	147.54	146.45	150.13
8	146.26	147.54	147.17	147.22	148.40	147.11	150.67
9	147.04	148.12	147.82	147.86	149.26	147.77	151.21
160	147.82	148.70	148.47	148.50	150.12	148.43	151.75
1	148.60	149.28	149.12	149.14	150.98	149.09	152.29
2	149.38	149.86	149.77	149.78	151.84	149.75	152.83
3	150.16	150.49	150.42	150.42	152.70	150.45	153.37
4	150.94	151.02	151.07	151.06	153.56	151.11	153.91
5	151.72	151.60	152.72	151.70	154.42	151.77	154.45
6	152.50	152.18	153.37	152.34	155.28	152.43	154.99
7	153.28	152.76	154.02	152.98	156.14	153.09	155.53

and the average width of head for a series is 154 mm. A given individual "A" has a head width of 158 mm. and a face width of 148 mm. The head width has diverged from the average of the series 4 mm. Our coefficient of regression indicates that on the average the width of face diverges from the average 0.7 of a unit for every unit of change in head width. Consequently we may assume that "A," who has diverged

TABLE LXXIII.

Width of Face Reduced to the Standard of the Average Width of Head

Reduced Series Compared to Original Series in ( )

Mm.	Cases	Percent
128		
9	(1)	(.3)
130	2 (2)	.6 (.6)
1	1 (1)	.3 (.3)
2	1 (2)	.3 (.6)
3	1 (4)	.3 (1.2)
4	1 (0)	.3 (.0)
5	2 (1)	.6 (.3)
6	5 (4)	1.5 (1.2)
7	5 (13)	1.5 (3.9)
8	8 (15)	2.4 (4.6)
9	10 (13)	3.0 (3.9)
140	14 (18)	4.2 (5.5)
1	22 (19)	6.7 (5.8)
2	32 (28)	9.8 (8.5)
3	27 (23)	8.2 (7.0)
4	32 (15)	9.8 (4.5)
5	24 (20)	7.3 (6.1)
6	26 (30)	8.0 (9.1)
7	35 (21)	10.7 (6.4)
8	35 (27)	10.7 (8.2)
8	16 (13)	4.8 (3.9)
150	9 (15)	2.7 (4.6)
1	5 (13)	1.5 (3.9)
2	1 (10)	.3 (3.0)
3	6 (3)	1.8 (.9)
4	4 (5)	1.2 (1.5)
5	2 (1)	.6 (.3)
6	1 (6)	.3 (1.8)
7	1 (0)	.3 (.0)
8	(5)	(1.5)
Totals	328 (328)	99.7 (99.4)
Average	144.5	(144.5)
σ	$\pm$4.34	($\pm$5.37)
	$\pm$ .24	(e .29)

4 mm. from the average in head width has also diverged .7 × 4 or 2.8 mm. in face width. By subtracting 2.8 mm. from 148 mm. we reduce "A's" face width to the standard of the average width of head. In case of a minus deviation the correction would be added.

If our assumption that individuals with a narrow head inherit a narrow face and those with a wide head inherit a wide face is true we shall expect our bimodal distribution to persist. If, on the other hand, our bimodal distribution is accidental the reduction to the standard of average width of head should give us a normal distribution. The results of such procedure are given in Table LXIII and Fig. 2.

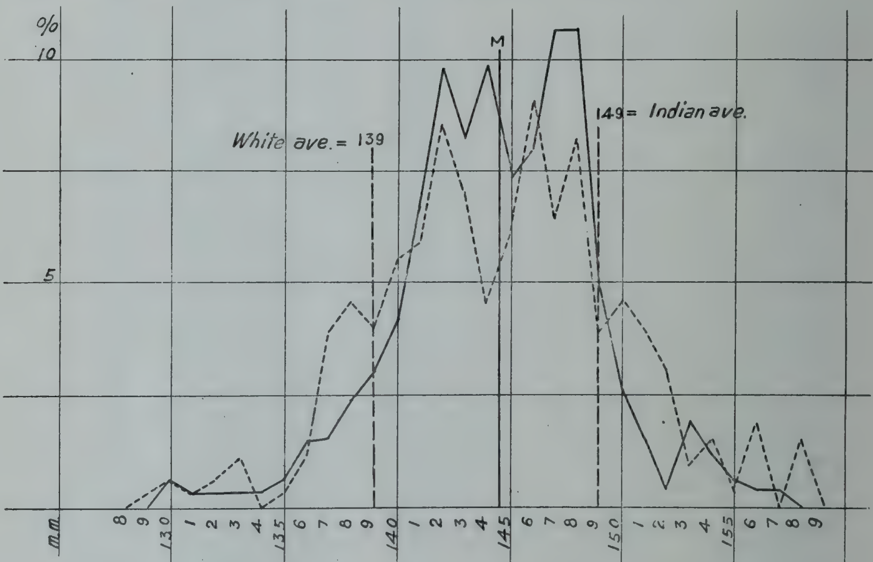

Fig. 2. Distribution of Face Width in Reduced Series compared to Distribution in Original Series. ————Reduced Series. ....Original Series.

The results have been to produce a series much less variable in face width. Many of the extreme cases have been eliminated. Although not quite as marked, our bimodal distribution with modes at 142–4 and 147–8 and a low frequency at the average 144–6 persist. It seems safe then to conclude that the distribution is bimodal and that a very definite correlation exists between width of face and width of head. This correlation is increased by intermixture. There is little or no disharmonic heredity in these two characters. Much has been made of misfit anatomical structures due to the crossing of widely different races. This is one instance at least in which the harmonic relationship between two characters is retained in the hybrid offspring.

V. CONCLUSIONS.

TABLE LXXIV.

Summary of Anthropometric Results.
(Ages 20–59)

	Male		Female	
	Pure Sioux	Half-bloods	Pure Sioux	Half-bloods
No. of cases	540	77	157	24
Stature	172.4	173.5	160.0	161.2
σ $\pm$	5.64	6.81	5.29	5.79
Shoulder Height	142.7	142.3	132.5	133.2
σ $\pm$	5.03	6.07	4.89	5.23
Shoulder Width	38.8	38.9	35.5	35.4
σ $\pm$	1.92	1.89	2.09	2.21
Index of Shoulder Width	22.5	22.4	22.4	21.9
σ $\pm$	1.10	1.01	1.20	1.35
Sitting Height	88.5	89.6	82.1	83.0
σ $\pm$	3.50	4.39	3.49	4.91
Index of Sitting Height	51.4	51.6	51.4	51.4
σ $\pm$	1.68	1.94	1.90	2.75
Arm Reach	181.4	182.2	168.3	167.4
σ $\pm$	7.03	6.99	6.43	6.79
Index of Arm Reach	105.2	105.0	105.3	103.8
σ $\pm$	2.41	2.19	2.32	1.75
Arm Length	77.0	77.3	71.8	71.0
σ $\pm$	3.57	3.28	2.63	3.59
Index of Arm Length	44.6	44.6	44.9	44.1
σ $\pm$	1.47	1.26	1.68	1.29
Head Length	194.9	194.4	187.0	187.3
σ $\pm$	6.16	7.12	5.09	4.17
Head Width	155.1	154.3	150.9	150.3
σ $\pm$	5.39	5.04	4.83	4.50
Cephalic Index	79.6	79.4	80.5	80.5
σ $\pm$	3.20	2.64	2.68	2.85
Face Width	149.1	143.4	142.8	139.3
σ $\pm$	5.45	5.49	5.05	3.70
Cephalo-Facial Index	96.1	92.9	94.7	92.5
σ $\pm$	3.22	3.23	3.22	1.88
Height of Face Physiognomic	189.9	186.4	179.4	173.6
σ $\pm$	8.32	7.27	8.12	5.65
Height of Face: Anatomic	124.6	121.5	117.4	114.1
σ $\pm$	6.39	6.36	6.18	4.12
Facial Index: Anatomic	83.6	84.8	82.3	82.2
σ $\pm$	4.84	5.28	4.40	3.27
Nose Height	58.3	54.9	55.2	51.5
σ $\pm$	3.94	3.55	3.51	2.95
Nose Width	39.9	37.6	37.4	34.8
σ $\pm$	3.22	3.04	2.91	2.27
Nasal Index	68.8	69.2	68.0	67.8
σ $\pm$	7.05	7.08	7.09	6.42

We have seen that the seventeen local groups of Sioux Indians here described may be justly included in a single series since they show no marked differences in the descriptive or anthropometric characters recorded. In spite of the fact that it is impossible to segregate the different elements they are on the whole a rather variable group in all characters, due in most instances to a number of very extreme cases rather than to irregular distribution within the curve proper. The variability in most characters approaches very closely the variability of some of our more civilized national groups.

Again this investigation brings out the fact that we cannot rely wholly on the coefficient of variability as an index of homogeneity of type. When a given character is very similar for two groups the one which is racially more pure may show a higher degree of variability than the one which is the more heterogeneous. On the whole the seriation tables and curves of distribution bring out the differences between two groups more clearly. In our present investigation we found the half-bloods more variable than the full-bloods in stature, shoulder height, sitting height, absolute and relative, head length, face width, cephalo-facial index, facial index, and nasal index. In the remaining twelve of the twenty-one observations recorded the full-bloods are slightly more variable. In a greater number of observations, however, the distribution among the half-bloods was more irregular.

In our correlations we found the closest relationships to exist between diameters in the same axis such as stature and arm reach, stature and arm length, stature and sitting height, and width of head and width of face. A fair degree of correlation exists between gross diameters in opposite axes such as stature and width of shoulder. Other diameters in different axes such as length and width of head, height and width of face and height and width of nose show a lower degree of correlation. The differences in the degree of correlation of two diameters in full-bloods and half-bloods are not very great. On the whole it does not seem as if intermixture has seriously affected the degree of correlation between the various diameters. In the instance of face width and head width the correlation seems to be increased by intermixture. We found that individuals with a narrow head had a strong tendency to inherit the European type of face while those with a wide head had a tendency to inherit the Indian type of face. The greatest difference is in the correlation between length and width of head. The coefficient among half-bloods is twice that of the full-bloods. On the other hand, however, we found a lowered degree of correlation in half-bloods in those diameters

which differed most widely in Indians and whites. Face width is the exception.

In regard to such characters as skin color, hair color, eye color, and hair form it seems that the half-bloods approach the Indian more closely than they do the whites. In regard to the amount of hair on the face (beard and moustache) the half-bloods seem to stand intermediate between Indians and whites.

The anthropometric characters bring out two points of interest. First, that in general body form and proportions these Indians are not very different from the whites with whom they have mixed. There are practically no differences between the full-bloods and half-bloods in absolute or relative shoulder height, shoulder width, sitting height, arm length, arm reach and very small differences in cephalic, facial, and nasal indices.

Second, by far the most noticeable and consistent differences are differences in absolute size. The half-bloods are taller than the full-bloods in the case of both males and females, children and adults. On the other hand, the full-bloods have the more massive heads, faces, and noses. While the relation of the diameters of these parts as expressed by indices are very much alike the absolute diameters are different. The most marked difference is in the width of the face.[1] The full-bloods have a much wider face than the half-bloods or whites. At the same time the face is higher both in respect to total height or in respect to any of its component parts. The area of the face in full-bloods is considerably greater than that of half-bloods or whites. Also the full-bloods have the longer and wider heads and the higher and wider noses. The relation of the transverse diameter of the face to the transverse diameter of the head is also very different. The width of the face more nearly approaches the width of the head among full-bloods.[1] At the same time, in so far as our comparative data will allow us to judge, it seems that in those characters in which the Indian differs most markedly from whites the half-bloods stand more closely to the Indians than to the whites.

In regard to growth our data are too scanty for generalizations. The absolute dimensions and a majority of the indices increase with age. The cephalic index decreases slightly and the nasal index decreases markedly with age. The height sitting and shoulder width indices

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[1]Compare also Jenks, 1916.

decrease until the period of rapid growth after which there is a slight increase. The index of arm reach shows a slight decrease until the period of rapid growth during and after which there is a rapid increase.

In conclusion some statement as to the relationship of the Sioux Indians to other North American Indians seems desirable. Detailed measurements on nearby tribes are scarce. The following data however are available for adult male full-bloods:—

	Sioux	Chippewa (Hrdlicka)	Shoshoni (Boas)	Pima (Ten Kate)	Maricopa (Ten Kate)
No. of Cases	540		109	77	29
Stature	1724.1	1719.0	1661.0	1696.0	1722.0
Index of Height Sitting	51.4			50.8	50.9
Index of Arm Reach	105.2			103.9	104.7
Index of Arm Length	44.6			43.5	43.7
Cephalic Index	79.6	79.6	79.5	78.7	82.9
Facial Index	83.6	83.7	80.5	86.8	87.4
Nasal Index	68.8	75.5	83.1	81.7	85.2
Cephalo-Facial Index	96.1				
Head Length	194.9	199.0	192.3	190.0	188.8
Head Width	155.1	158.0	152.8	150.0	156.3
Face Width	149.1	151.5	147.5	146.2	149.7
Face Height	124.6	124.5	118.7	127.5	129.9
Nasal Height	58.3	56.5	52.2	48.8	49.0
Nasal Width	39.9	42.8	43.4	39.0	41.4

Of these groups the Chippewa (Ojibway) of Hrdlicka shows the greatest similarity. In nearly every measurement and index the averages are in very close agreement. There can be no doubt that these two groups are very closely related.

In so far as we can judge from stature and head form the Sioux are uniform in physical type with a majority of the Plains tribes and possibly also with some other nearby groups. The relationship of the Sioux to the Blackfoot, Cheyenne, Arapaho, Crow, Pawnee, Kutenai, Ojibway, Chippewa, Micmac, Abnaki, Delaware, Iroquois, Ottawa, and Menomini is suggested by these averages. In the case of the Blackfoot, Cheyenne, Arapaho, Crow, Pawnee, Kutenai, Ojibway, and Chippewa the relationship is also indicated by their physiognomy. The form of the nose and profile is very similar. Only slightly more divergent are the Omaha, Kiowa, and Arikara. However, it is useless to establish physical types on such meager details.

The following data are available on stature and head form:—

Stature in Centimeters	Cephalic Index 79	80	81	82
175		Cheyenne		
174				Creek
173	Arapaho Oneida Iroquois		Crow	Omaha
172		Sioux, Blackfoot, Chippewa, Micmac, Abnaki, Delaware		Eastern Ojibway
171		Western Ojibway, Pawnee		Kiowa Western Cherokee
170	Pima		Ottawa Menomini	Choctaw Papago
169		Kutenai		Arikara
168		Cree		Eastern Cherokee Chickasaw
167				
166		Shoshoni Ute		

We may conclude by saying that the Sioux are among the very tallest of the American Indians among whom we find the average stature ranging from the 153 centimeters of the Guaranis of South America to the 175 centimeters of the Maricopa and Cheyenne. The Sioux are exceeded in stature only by these two latter tribes, the Bororo of South America, the Creek of the Southeastern United States, the Tlingit, Winnebago, Iroquois, and a few closely related Plains groups, the Arapaho, Omaha, and Crow. In head form they are mesocephalic, which characteristic they share with a large number of North and South American groups, among which are a majority of the tribes of the Plains, the Eastern Woodlands, Mackenzie area and a number of tribes in Southern California, and the Southwestern United States.

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174'

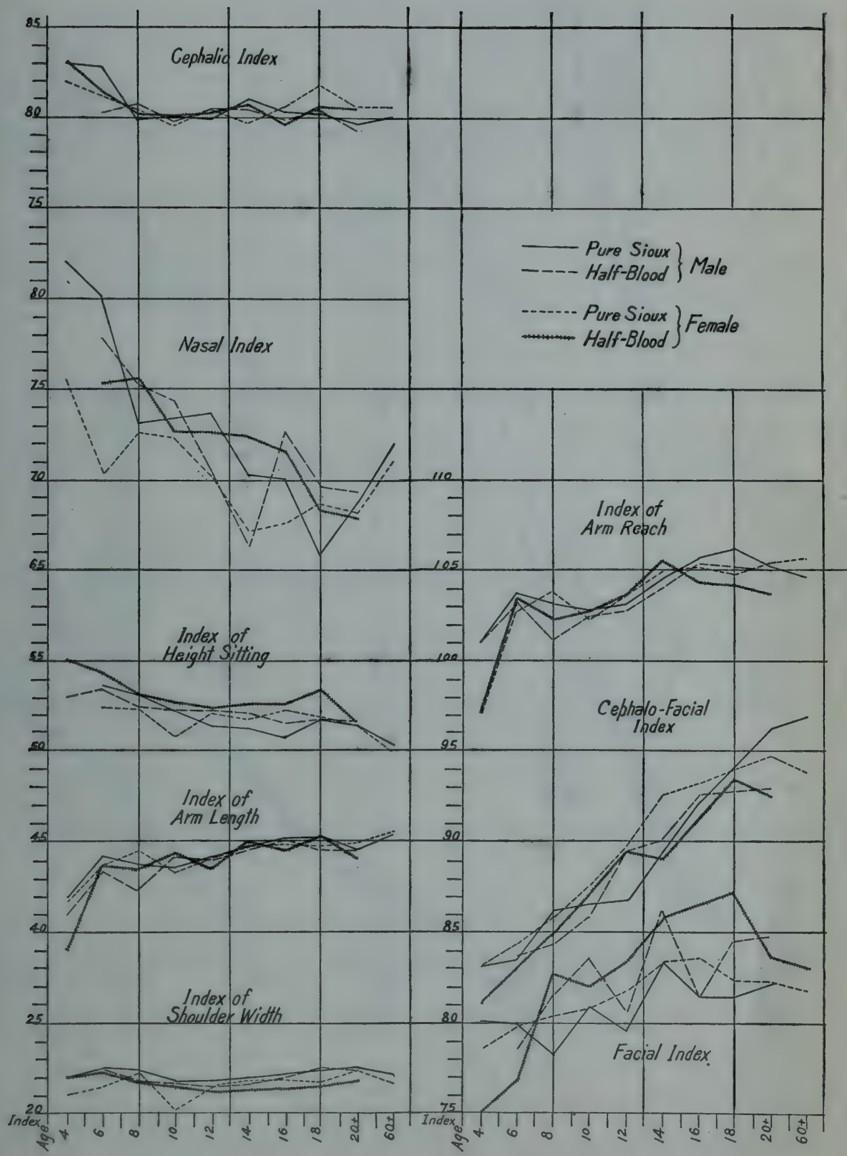

Fig. 3. Growth: Indices.

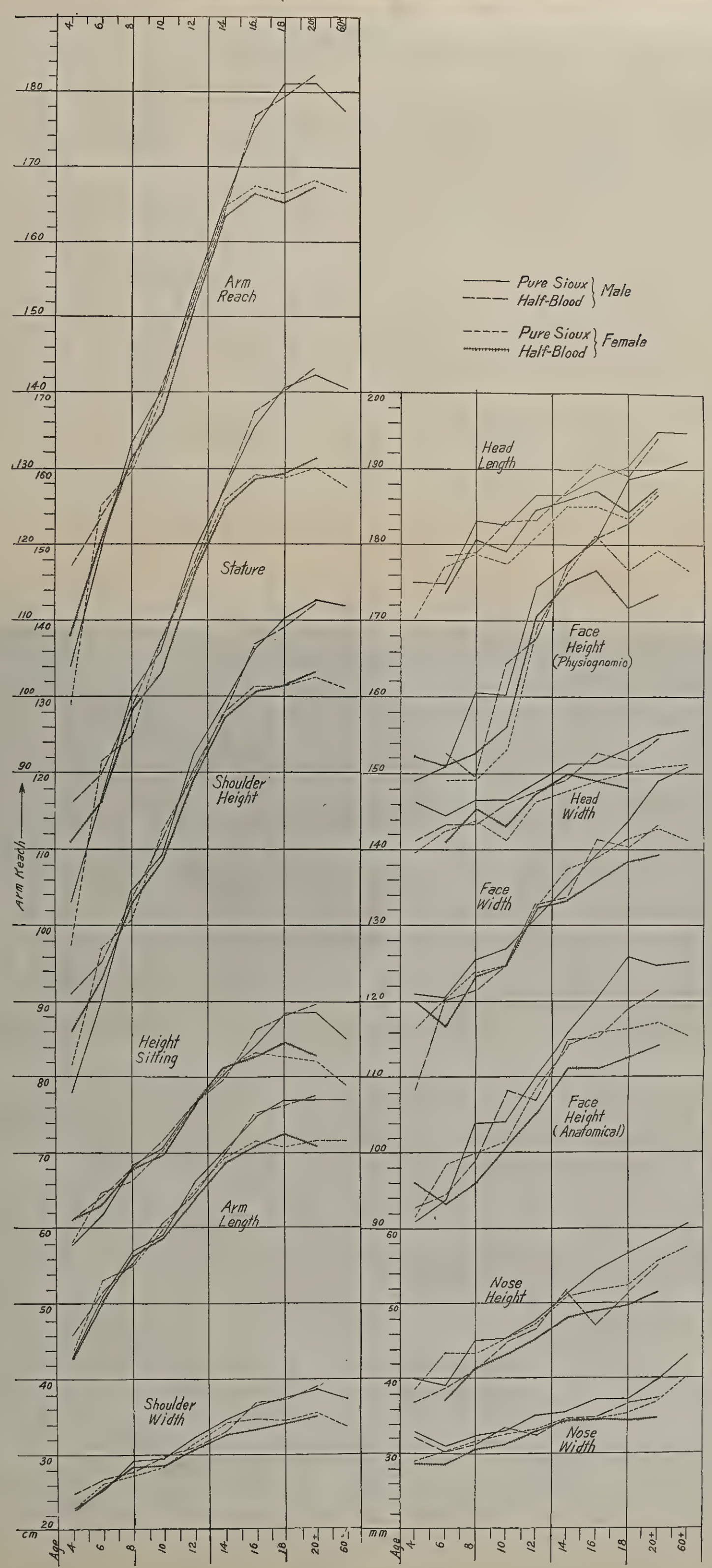

Fig. 4. Growth: Absolute Dimensions.

174²

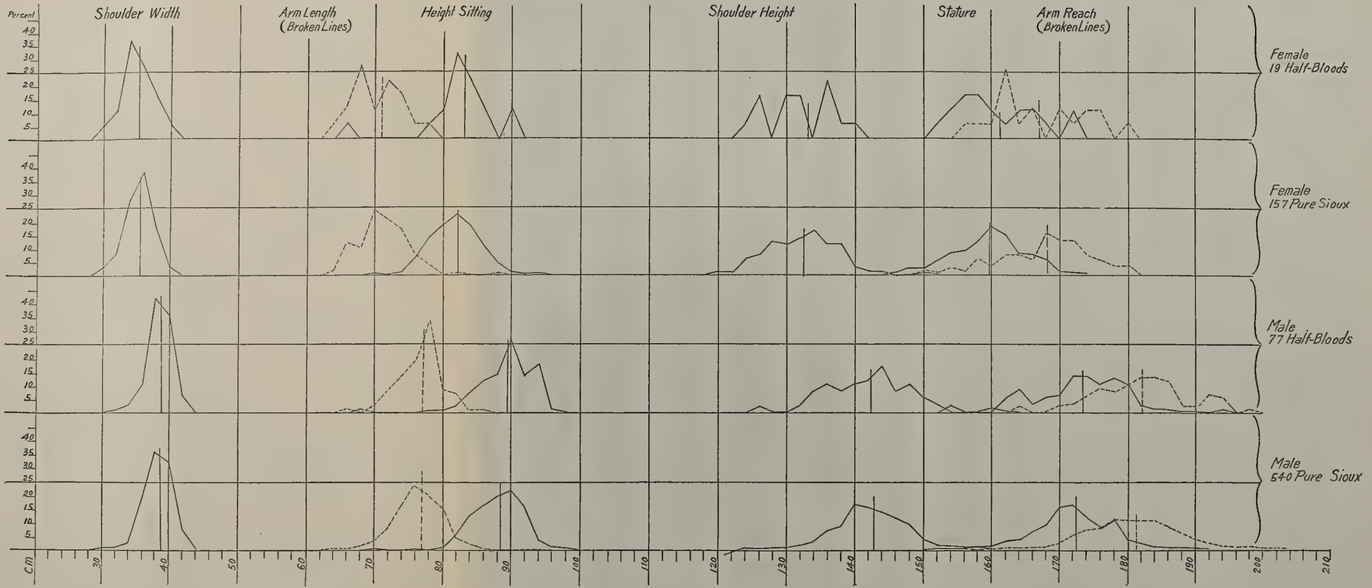

Fig. 5. Graphic Distribution of Absolute Body Measurements.

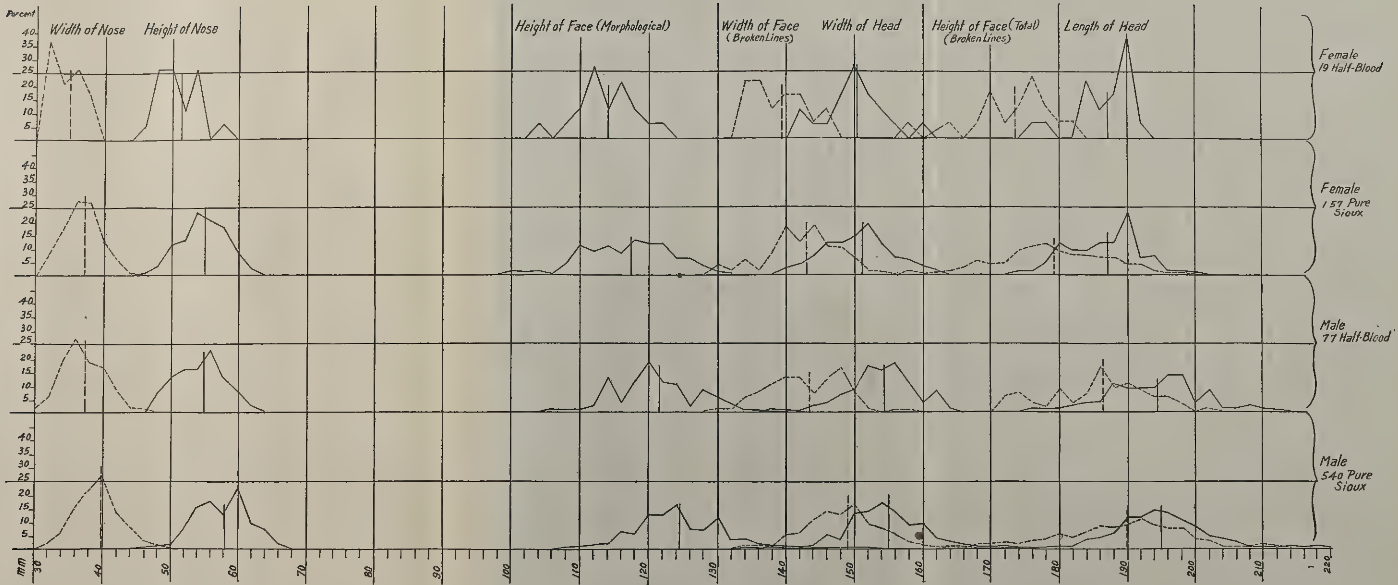

Fig. 6. Graphic Distribution of Absolute Head and Face Measurements.

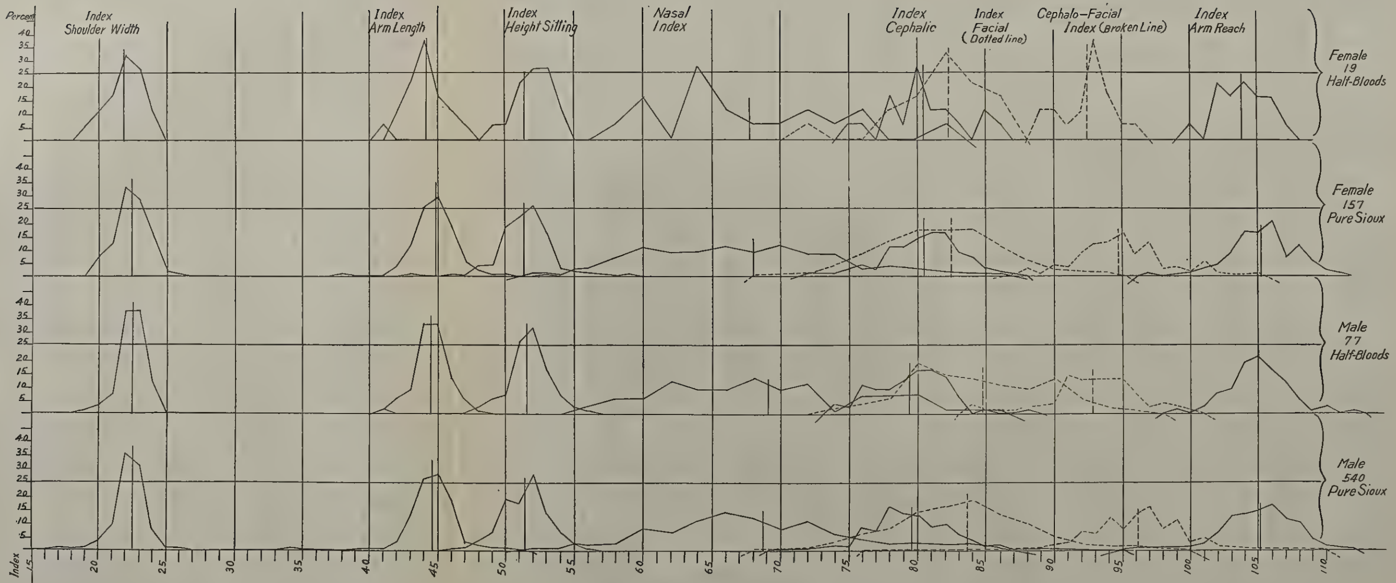

Fig. 7. Graphic Distribution of Indices.

ANTHROPOLOGICAL PAPERS

OF

THE AMERICAN MUSEUM OF NATURAL HISTORY

Vol. XXIII, Part IV

A FEW ANDAMANESE SKULLS WITH COMPARATIVE NOTES ON NEGRITO CRANIOMETRY

BY

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A FEW ANDAMANESE SKULLS WITH COMPARATIVE NOTES ON NEGRITO CRANIOMETRY.

By Louis R. Sullivan.

CONTENTS.

ILLUSTRATIONS.

Text Figures.

Tables.

Introduction.

In the ethnological collections of the American Museum of Natural History are three skulls, without mandibles, and four separate mandibles from the Andaman Islands. They are all decorated with strips of a coarse cloth to which are attached numerous shells. Two of the skulls are colored with a red pigment, presumably an iron oxide, and striped with white pigment. The third skull is not colored, but is rather highly polished, perhaps through much handling. All of these specimens are said to have been worn by relatives in honor of the dead. Although a few Andamanese skulls have been published, it seems that they are still sufficiently rare to warrant the description of this small collection and the addition of comparative notes from the data at present available.

September, 1919. Louis R. Sullivan.

Description of the Material.

The observer is immediately struck with the marked similarity of the three skulls in general contour, especially in the contours of the norma verticalis and norma occipitalis. Two of the specimens are male and one is female. They are all small in general proportions, yet the faces are proportionately much smaller than the brain cases, giving the skulls, especially the female specimen, an infantile appearance.

Norma verticalis. The contour in this view is strongly rhomboidal. The frontal region is narrow while the parietal region is relatively broad and the parietal eminences are very prominent.

Norma lateralis. The glabella is smooth and the supraorbital eminences are practically absent. Only in the males do we find a very faint trace of them. In all three specimens the frontal rises vertically for three or four centimeters and then slopes rather abruptly toward the bregma. In the region of the pterion the spheno-parietal suture is very short and in one instance (70.0–1126f) we have small bilateral epipterics in this region. A short spheno-parietal articulation with a tendency to the formation of epipteric bones or to be replaced by a fronto-temporal articulation seems to be characteristic of Andamanese crania. In seven skulls Turner[1] found one having bilateral epipterics and another with an epipteric on the right side and a fronto-temporal articulation on the left side. Flower[2] also called attention to this feature.

Norma facialis. The nasal bones are small and flat. The nasal aperture is ovoid or ovoid-triangular. The lower border of the pyriform aperture is infantile in one case, the female, while in the other two it is intermediate between the infantile form and the prenasal fossae. The canine fossae are shallow in the female and of medium depth in the two males. No metopic sutures are present. In the other specimens described, however, metopism seems to be fairly common. In forty-eight specimens examined (but not all measured) by Flower, six were metopic. This is a frequency of about 12.5 percent. In seven specimens Turner found one metopic and in a like number Gupte[3] found one metopic. Metopism seems to be characteristic in from 12 to 14 percent of the cases.

Norma basilaris. The alveolar arch is diverging. The posterior nasal spine is short and wide. The glenoid fossae are deep in one and of medium depth in two others. The mastoid processes are very small in

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[1]Turner, 1901.
[2]Flower, 1880.
[3]Gupte, 1909.

every case. The foramina are normal. The molar teeth are present in two cases and are of average size, but rather large for the size of the skulls. m^1 and m^2 are quadritubercular. m^3 is tritubercular secondarily in one case, while in the other it is distorted. It is quadritubercular but the hypocone has rotated mesially thus greatly increasing the lateral diameter of the tooth.

The Mandibles. The mandibles are all small. Two appear to be male and two female. The gonia are slightly everted. The symphysis is low. The chin is median in every case and poorly developed, being best described by the term neutral. The molars all have five cusps.

In Table I the detailed measurements are given, in Table II the indices and angles, and in Table III the measurements of the mandibles.

TABLE I

MEASUREMENTS OF ANDAMANESE SKULLS

Catalogue Number	70.0–733	70.0–734	70.0–1126
Sex	Male	Male	Female
Cranial Capacity (with millet)	1280	1280	1170
Greatest Length (Glabella-Opisthocranion)	162	166	161
Greatest Breadth	133	139	128
Basion-bregmatic Height	136	137	126
Ear Height (Verticale to horizontal plane)	114	114	106
Minimum Frontal Breadth	86	94	84
Basion-Nasion Length	90	99	92
Basion-Prosthion Length	92	96	94
Bizygomatic Diameter	120	125	113
Upper Face Height (Nasion to Prosthion)	61	68	59
Nasal Height	44	52	43
Nasal Breadth	23	23	22
	L R	L R	L R
Orbital Width (from Maxillo-frontale)	35–35	40–40	38–37
Orbital Height	31–31	33–33	32–33
Maxillo-Alveolar Length	51	56	49
Maxillo-Alveolar Breadth	60	64	59
Palate Length	41	45	40
Palate Breadth	35	40	34
Foramen Magnum Length	33	29	29
Foramen Magnum Breadth	31	27	24
Horizontal Circumference	466	477	455
Median Sagittal Arc	356	359	339
Transverse Bregmatic Arc	304	309	291

TABLE II

Indices and Angles

Catalogue Number	70.0–733	70.0–734	70.0–1126
Sex	Male	Male	Female
Indices:			
Length-Breadth	82.1	83.7	79.5
Length-Height	84.0	82.5	78.3
Breadth-Height	102.3	98.6	98.4
Length Ear-Height	70.4	68.7	65.8
Transverse Fronto-Parietal	64.7	67.6	65.6
Alveolar Projection	102.2	97.0	102.2
Transverse Cranio Facial	90.2	89.9	88.3
Upper Facial	50.8	54.4	52.2
Nasal	52.3	44.2	51.2
	L R	L R	L R
Orbital	88.6–88.6	82.5–82.5	84.2–89.2
Maxillo-Alveolar	117.6	114.3	120.4
Palatal	85.4	88.9	85.0
Foramen Magnum	93.9	93.1	82.8
Angles formed with Ear-Eye Horizontal:			
Profile Angle	75°	82°	77°
Nasal Angle	78°	83°	80°
Alveolar Angle	63°	75°	66°
Glabella-Bregmatic Angle	52°	50°	44°
Nasion-Bregmatic Angle	56°	52°	50°

TABLE III

Measurements of Mandibles

Catalogue Number	70.0–736	70.0–1127	70.0–735	70.0–737
Sex	Male	Male	Female	Female
Bigonial Breadth	94	94	85	89
Minimum Breadth of Ramus	29	30	27	27
Height of Symphysis	28	30	30	..
Height between $m_{\overline{1}}$ and $m_{\overline{2}}$	25	26	23	20

Comparison with Other Studies.

Obviously one cannot with any degree of confidence describe a racial type from the study of three skulls and four mandibles. Yet it is safe to say that one could do this with greater accuracy for the Andamanese than for most groups of mankind. On first seeing these skulls I was at once struck with their fundamental similarity. A survey of the literature on the Andamanese has substantiated the fact that the skull of the Andamanese offers more distinctive points to the eye than do the skulls of most groups. It was very easy to establish that these skulls were genuine inasmuch as they agree in nearly every detail with those described and figured by other writers. Nor have I found any skulls of other groups which might be confused with the skull of an Andamanese.

The earliest descriptions of Andamanese skulls of which I find any record are those described by Owen, Busk, and Davis. Owen[1] describes a single skull. He published two plates (1861) giving four views of this skull, but no measurements. Busk[2] describes two Andamanese skulls and gives measurements. But the measurements taken are antiquated and not comparable with those now in use. Fortunately Professor Flower[3] later re-measured these same two skulls. J. Barnard Davis in his *Thesaurus Craniorum* describes four skulls and two mandibles. Unfortunately, again, Davis's measurements are for the most part not comparable with those taken by modern workers. They are also recorded in inches. Cranial capacity is given in terms of weight. Quatrefages and Hamy[4] describe and measure two Andamanese skulls, one male and one female. Some of their measurements are comparable with those used today. We are indebted to Professor Flower[5] for the greatest contribution to this subject. He has published two papers on the Andamanese. In the first he describes and measures twelve male and twelve female skulls. In his second paper he describes a few more but does not give individual measurements. In his catalogue he records the measurements of all the Andamanese skulls in the Royal College of Surgeons, England. In 1901 Sir William Turner[6] described and measured seven Andamanese skulls. Gupte[7] later described seven specimens from the

[1]Owen, 1861 and 1863.
[2]Busk, 1866.
[3]Flower, 1880.
[4]Quatrefages and Hamy, 1882.
[5]Flower, 1880, 1884, and 1879 (1907).
[6]Turner, 1901.
[7]Gupte, 1909.

Indian Museum, Calcutta. Doubtless a search through the German catalogues might reveal a few others. But without much doubt the foregoing are the more important contributions to the subject. A majority of the skulls are known to have come from the neighborhood of the English settlement at Port Blair.

On account of the earlier unstandardized methods of measuring skulls much data are not available for comparison. As previously stated the work of Davis and Busk has been excluded for this reason. A majority of the measurements of the later workers are comparable. Very unfortunately Professor Flower has taken the ophryon as a measuring point for the length of the skull and height of the face. Cranial capacity has been measured by the use of millet and mustard seed by all except Turner who used No. 8 shot. The orbital width has been taken from the dacryon by a majority of the workers. Flower appears to have used the lacrimale. I prefer the maxillo-frontale. The following measurements are probably comparable throughout:—

1. Maximum breadth of the skull.
2. Minimum frontal breadth.
3. Basion-bregmatic height.
4. Nasion-basion length.
5. Nasion-prosthion length.
6. Bizygomatic breadth.
7. Nasal height.
8. Nasal breadth.
9. Nasal index.
10. Cranio-facial index.
11. Alveolar index.

The horizontal circumference cannot be used, nor with any degree of surety the median sagittal and transverse arcs.

Cranial Capacity. In his earlier paper (1880) Flower measured cranial capacity by means of mustard seed. In 1884 he substituted lead shot. His results are as follows:—

	13 Males	13 Females
Mustard seed	1244 cc.	1128 cc.
Lead shot	1281 cc.	1148 cc.

Since Flower did not give the individual measurements with shot I have taken his earlier observations with mustard seed and combined them with those of Gupte and our present series taken with millet.

	18 Males	14 Females	*37 Both Sexes
Average	1268.9	1127.8	1198.9
σ	±104.6	±59.9	±104.9
e	±24.6	±16.0	±17.2
√	8.24%	5.31%	8.75%
Minimum	1070	1020	1020
Maximum	1520	1250	1520

(*Includes five not sexed.)

The modes are 1280 and 1100 for the males and females respectively. The one extreme case of 1520 cc., for a male skull perhaps raises the averages unduly. In the comparative tables of Martin only the Vedda (Sarasin) and the Papuan (Sergi and Moschen) groups have a lower cranial capacity. The averages given are Vedda 1250 and 1139 and Papuans 1236 and 1125. The number of cases in both of these instances is small.

Length, Breadth, and Cranial Index. As previously stated the fact that Flower has measured the length from the ophryon has dissected our series into two small groups so that the real value of the cranial index is uncertain. Ordinarily it would seem that the length from the ophryon would be less than that from the glabella. In the case of the Andamanese this is probably not true. Comparative measurements are given below:—

	Glabella Length (Turner, Gupts, etc.)	Ophryon Length (Flower)		Difference
10♂	164.9	13♂	168.0	3.1
6♀	160.7	12♀	160.7	0.0
3?	163.4	4?	162.0	-1.4
19 Total	163.3	29 Total	164.2	0.9

Were the series larger we might add to or subtract from Flower's measurement an average correction. But in the present instance such a procedure does not seem advisable. While Flower's measurements seem to exceed those of other workers in all the groups except the unsexed skulls we can be by no means certain that Flower was not dealing with a series of larger skulls. The fact that his average cranial capacity is slightly larger and also that his measurements of head breadth are in excess of those of the other series seems to indicate that the skulls with which he was dealing are actually somewhat larger.

TABLE IV

MEASUREMENTS AND INDICES OF ANDAMANESE SKULLS

(Calculated from the Data of Flower, Turner, Gupte, Quatrefages, and Sullivan)

Measurement	No.	Sex	Average	σ±	e±	V in %	Minimum	Maximum
Cranial Capacity (millet)	18	M	1269	104.60	24.60	8.24	1070	1520
" " "	14	F	1128	59.90	16.00	5.31	1020	1250
" " "	37	MF	1199	104.90	17.20	8.75	1020	1520
Greatest Length	10	M	164.9	......	......	....	....	....
" "	6	F	160.7	......	......	....	....	....
" "	19	MF	163.3	......	......	....	....	....
Greatest Breadth	23	M	136.1	4.09	.85	3.00	128	145
" "	18	F	131.8	2.82	.66	2.14	126	137
" "	48	MF	134.4	4.24	.61	3.15	126	145
Cranial Length-Breadth Index	10	M	83.4	......	......	....	....	....
" " "	6	F	81.0	......	......	....	....	....
" " "	19	MF	82.5	......	......	....	....	....
Basion-Bregmatic Height	23	M	130.2	4.92	1.03	3.77	120	140
" "	18	F	124.2	3.18	.75	2.56	118	131
" "	47	MF	127.3	5.03	.73	3.95	118	140
Cranial Breadth-Height Index	23	M	95.7	4.06	.84	4.24	87	102
" " "	18	F	94.2	2.13	.50	2.26	90	98
" " "	46	MF	94.9	3.55	.52	3.74	87	102
Minimum Frontal Breadth	21	M	92.2	4.28	.93	4.64	85	102
" " "	17	F	89.2	2.69	.65	3.01	84	94
" " "	42	MF	90.7	4.00	.61	4.41	84	102
Transverse Fronto-Parietal Index	21	M	68.1	3.34	.72	4.90	63	75
" " "	17	F	67.8	2.40	.56	3.54	64	74
" " "	42	MF	67.8	3.05	.47	4.49	62	75
Bizygomatic Diameter	22	M	124.6	5.30	1.13	4.25	112	136
" "	17	F	117.7	2.81	.68	2.38	113	123
" "	40	MF	121.8	5.70	.90	4.67	112	136
Transverse Cranio-Facial Index	22	M	91.6	4.59	.98	5.01	80	103
" " "	17	F	89.0	2.38	.58	2.67	87	95
" " "	40	MF	90.7	4.10	.64	4.52	80	103
Basion-Nasion Length	22	M	93.4	4.27	.91	4.57	83	101
" "	17	F	90.8	2.55	.61	2.81	86	95
" "	45	MF	92.3	3.72	.55	4.03	83	101
Basion-Prosthion Length	22	M	93.4	5.14	1.12	5.50	82	102
" "	17	F	92.5	3.86	.93	4.17	86	97
" "	45	MF	93.0	4.45	.66	4.78	82	102
Index of Alveolar Projection	22	M	100.3	2.79	.59	2.78	97	107
" " "	17	F	101.8	3.45	.83	3.38	96	108
" " "	45	MF	100.9	3.39	.50	3.36	96	109
Total Anatomical Face Height	4	M	99.2	......	......	....	......	....
" " " "	3	F	92.0	......	......	....	....	....
" " " "	8	MF	94.6	......	......	....	....	....
Upper Anatomical Face Height	9	M	61.0	......	......	....	....	....
" " " "	5	F	56.6	......	......	....	....	....
" " " "	17	MF	58.9	......	......	....	....	....
Nasal Height	23	M	45.8	2.93	.61	6.39	40	52
" "	18	F	43.2	1.34	.32	3.10	41	46
" "	48	MF	44.8	3.07	.44	6.85	40	54
" Width	23	M	23.3	1.54	.32	6.61	20	26
" "	18	F	22.5	1.17	.27	5.20	21	25
" "	48	MF	22.9	1.56	.22	6.81	18	26
" Index	23	M	51.0	3.03	.63	5.94	44	58
" "	18	F	52.0	1.55	.36	2.98	49	58
" "	48	MF	51.2	2.89	.41	5.64	44	58
Orbital Width (from Dacryon)	20	M	36.7	1.34	.30	3.65	35	40
" " " "	16	F	35.7	1.26	.31	3.53	34	39
" " " "	43	MF	36.2	1.62	.24	4.47	33	40
" Height	21	M	32.7	1.31	.28	4.00	30	35
" "	17	F	31.8	1.14	.27	3.58	30	34
" "	43	MF	32.3	1.34	.20	4.14	30	35
" Index	21	M	89.0	4.48	.98	5.03	79	95
" "	17	F	89.1	4.00	.97	4.48	81	97
" "	43	MF	89.3	4.33	.64	4.84	79	97
Maxillo-Alveolar Length	9	M	49.3	......	......	....	....	....
" "	5	F	50.6	......	......	....	....	....
" "	16	MF	49.6	......	......	....	....	....
" Breadth	9	M	59.1	......	......	....	....	....
" "	5	F	57.4	......	......	....	....	....
" "	16	MF	58.8	......	......	....	....	....

Maxillo-Alveolar Index	9 Male	5 Female	16 Total
Average	120.7	113.2	119.2
Foramen Magnum Length	21 Male	19 Female	40 Total
Average	32.9	31.4	32.1
Foramen Magnum Breadth	14 Male	13 Female	27 Total
Average	28.0	26.7	27.4
Foramen Magnum Index	14 Male	13 Female	27 Total
Average	84.4	85.1	84.7
Bigonial Breadth (Mandible)	10 Male	15 Female	25 Total
Average	91.9	83.9	87.1
Symphysical Height (Mandible)	11 Male	14 Female	25 Total
Average	26.3	26.3	26.3

TABLE V

Measurements and Indices of Philippine Negrito Skulls

(Calculated from the Measurements by Koeze)

Measurement	No.	Sex	Average	σ±	e±	V in %	Minimum	Maximum
Cranial Capacity	34	M	1409	116.80	20.00	8.28	1140	1650
" "	18	F	1219	105.00	25.40	8.61	940	1420
" "	52	MF	1343	144.70	20.00	10.70	940	1650
Greatest Length	39	M	172.3	5.30	.85	3.07	160	183
" "	20	F	162.3	6.18	1.38	3.80	149	173
" "	59	MF	168.9	7.34	.95	4.34	149	183
" Breadth	38	M	143.7	4.03	.65	2.80	132	151
" "	20	F	135.9	4.99	1.11	3.67	119	143
" "	58	MF	141.0	5.80	.76	4.11	119	151
Cranial Length-Breadth Index	38	M	84.3	......	......	....	....	....
" " "	20	F	83.9	......	......	....	....	....
" " "	58	MF	84.0	......	......	....	....	....
Basion-Bregmatic Height	37	M	136.3	5.81	.95	4.26	127	152
" "	20	F	131.7	4.84	1.08	3.67	125	143
" "	57	MF	134.6	5.92	.78	4.39	125	152
Cranial Breadth-Height Index	37	M	95.3	3.39	.56	3.55	88	103
" " "	20	F	97.6	3.71	.83	3.80	89	105
" " "	57	MF	96.1	3.68	.48	3.83	88	105
Minimum Frontal Breadth	39	M	92.3	5.08	.83	5.50	83	102
" " "	21	F	89.5	3.88	.81	4.34	83	100
" " "	60	MF	91.2	4.84	.62	5.30	83	102
Bizygomatic Diameter	35	M	131.3	5.38	.91	4.09	120	145
" "	15	F	123.0	5.42	1.40	4.40	113	134
" "	50	MF	128.8	6.60	.93	5.12	113	145
Basion-Nasion Length	37	M	99.5	3.77	.62	3.78	92	106
" "	20	F	93.7	4.82	1.08	5.14	84	103
" "	57	MF	97.8	5.04	.66	5.15	84	106
Basion-Prosthion Length	35	M	95.4	5.58	.94	5.84	78	105
" "	14	F	90.7	5.82	1.55	6.41	79	100
" "	49	MF	94.0	6.03	.86	6.41	78	105
Index of Alveolar Projection	33	M	96.3	3.65	.63	3.79	89	105
" " "	14	F	98.1	4.36	1.12	4.44	89	104
" " "	47	MF	96.9	3.97	.57	4.09	89	105
Upper Anatomical Face Height	35	M	68.7	......	......	....	....	....
" " " "	16	F	62.9	......	......	....	....	....
" " " "	51	MF	66.9	......	......	....	....	....
Nasal Height	36	M	50.9	2.83	.47	5.56	44	58
" "	17	F	47.9	2.59	.62	5.41	41	51
" "	53	MF	49.9	3.08	.42	6.19	41	58
" Width	37	M	27.2	2.37	.38	8.71	24	37
" "	19	F	25.4	1.86	.42	7.32	22	28
" "	56	MF	26.6	2.25	.30	8.42	22	37
" Index	36	M	53.3	4.30	.70	8.06	45	64
" "	17	F	53.8	3.74	.91	6.84	48	61
" "	53	MF	53.5	4.14	.56	7.73	45	64
Orbital Width (maxillo-frontale)	39	M	42.2	1.92	.30	4.55	38	45
" " "	20	F	40.4	2.30	.51	5.69	36	46
" " "	59	MF	41.6	2.23	.29	5.36	36	46
" Height	39	M	35.3	1.67	.26	4.73	32	40
" "	20	F	34.3	1.86	.41	5.42	31	38
" "	59	MF	34.9	1.80	.23	5.15	31	40
" Index	39	M	83.2	4.53	.72	5.44	74	95
" "	20	F	84.6	4.23	.92	5.00	77	93
" "	59	MF	83.8	4.53	.59	5.40	74	95
Foramen Magnum Length	37	M	35.1	......	......	....	....	....
" " "	19	F	34.4	......	......	....	....	....
" " "	56	MF	34.8	......	......	....	....	....
" " Breadth	37	M	30.1	......	......	....	....	....
" " "	18	F	29.5	......	......	....	....	....
" " "	55	MF	29.9	......	......	....	....	....
" " Index	37	M	85.8	......	......	....	....	....
" " "	18	F	90.6	......	......	....	....	....
" " "	55	MF	87.5	......	......	....	....	....

Comparison of Breadth of Cranium in the Same Groups.

Other Series		Flower's Series		Difference
10 ♂	135.2	13 ♂	135.4	0.2
6 ♀	131.3	12 ♀	132.8	1.5
3?	135.3	4?	135.0	—0.3
19 Total	134.0	29 Total	134.3	0.3

But it seems safe to conclude that the measurement of length from the ophryon in the case of the Andamanese who have a poorly developed glabella and a vertical forehead has affected the cranial index in such a manner as to decrease it slightly and to make the Andamanese appear slightly more long-headed than in the case where the glabella is used as the measuring point. The averages for the cranial index are:—

Other Series		Flower's Series		Difference
10 ♂	83.4	13 ♂	80.7	—2.7
6 ♀	81.0	12 ♀	82.5	1.5
3?	83.6	4?	83.3	—0.3
19 Total	82.5	29 Total	81.8	—0.7

It is probable that 82.5 is more nearly the correct average for the group than 81.8. Yet the use of the two methods has made it impossible to make any statement as to the relationship of the cranial index in the sexes. The range of the index in both methods is from 77.0 to 89.0 in the males and from 79.0 to 87.0 in the females. As a group the Andamanese are decidedly brachycranial.

Nothing need be said of the other measurements since they are undoubtedly comparable, with the exception of those already noted. In Table IV I have listed the averages, variabilities, errors of the averages, coefficients of variation, and minimum and maximum measurements calculated from the data of Flower, Turner, Gupte, Quatrefages, and my own series. To these I have added in Table V the corresponding values for the series of Philippine Negrito published but not averaged by Koeze[1] and in Table VI the averages of a small series of Semang Negrito skulls compiled by Schlaginhaufen.[2] This last series is rather small but, so far as I have been able to determine, constitutes the bulk of the data on this group.

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[1]Koeze, 1901–1904.
[2]Schlaginhaufen, 1907.

TABLE VI

MEASUREMENTS AND INDICES OF SEMANG NEGRITO SKULLS

(Calculated from Data Compiled by Schlaginhaufen)

Measurement	Male		Female		Male+Female	
	No.	Average	No.	Average	No.	Average
Cranial Capacity	4	1338	3	1130	7	1248
Greatest Length	7	172.7	3	165.0	10	170.4
Greatest Width	7	134.7	3	131.0	10	133.6
Cranial Length-Breadth Index	7	78.1	3	79.4	10	78.9
Basion-Bregmatic Height	3	131.3	3	132.6	6	132.0
Cranial Breadth-Height Index	5	97.6	1	100.7	6	98.1
Minimum Frontal Breadth	5	90.4	3	91.3	8	90.7
Transverse Fronto-Parietal Index	1	70.8	1	68.1	2	69.5
Bizygomatic Diameter	6	128.6	3	125.0	9	127.4
Transverse Cranio-Facial Index	5	95.4	1	96.3	6	95.6
Basion-Nasion Length	6	97.0	3	98.0	9	97.3
Basion-Prosthion Length	6	96.5	3	96.3	9	96.4
Index of Alveolar Projection	6	99.4	3	98.3	9	99.1
Orbital Width	6	39.1	3	39.0	9	39.1
Orbital Height	6	32.1	3	33.0	9	32.4
Orbital Index	6	81.8	3	84.2	9	82.6
Nasal Height	6	46.3	3	47.0	9	46.5
Nasal Width	6	24.5	3	27.0	9	25.3
Nasal Index	6	52.6	3	57.5	9	54.2

Variability of the Series. For comparative purposes the range of variability is best studied by means of the coefficient of variability (V) which expresses the range of variation in terms of percentage of the average. These have been listed in Table VII. Since there are too few cases in the Semang series, the series of Naqada crania by Fawcett[1] has been substituted for comparative purposes. The variability is important from three points of view:—

First: for a comparison of the relative variability of the different measurements and indices.

Second: for a comparison of the relative variability in the sexes.

Third: for a comparison of the relative variability of the three groups.

[1]Fawcett, 1902.

Cranial capacity, nasal width, and the nasal index are the most variable in all three groups in both the male and the female crania. Only slightly less variable is the nasal height. On the other hand, greatest breadth and greatest length are the least variable throughout. In all the groups the breadth-height index also shows a small range of variation. Between these two extremes we have an intermediate group which shows considerable differences in the various groups. In the Andamanese and Philippine series the basion-prosthion length shows a large degree of variability. In the Naqada series it is less variable. Orbital height is about 50 per cent more variable in the Naqada series than in either the Andamanese or Philippine series. The other differences are more or less irregular and different in the two sexes of the same group.

The variability in the sexes of the three groups is quite different. In the Andamanese series the males are clearly the more variable. Of the sixteen measurements and indices recorded the males are the more variable in fifteen. The series of female Andamanese skulls show a remarkably small degree of variability throughout. In the Philippine series the females are the more variable in ten of the sixteen measurements recorded. In the Naqada the honors are about even in the two sexes, the males being the more variable in eight measurements and the females in seven. In all three groups the males are the more variable in the height, minimum frontal diameter, nasal width, and orbital index. In the other measurements the sexual differences are not as consistent.

The relative variability of the different groups is of considerable interest. Theoretically the more homogeneous groups racially should exhibit the lesser degree of variability. While such a theory obviously would not hold in the case of a single criterion, if a sufficiently large number of measurements are used to define and describe a series of skulls we should expect the results to follow this principle. In the case at hand we have sixteen measurements and indices to use as a criterion. According to the standards of the biometricians the Naqada series has been adjudged a fairly homogeneous group racially, much more so than we should expect to find on the average among racial groups of the present day. For this reason it will be of interest to compare the variability of the Andamanese and the Philippine Negrito with that of the Naqada series. In the Andamanese we should expect to find a low degree of variability since they probably approach more closely than most other peoples to our conception of a homogeneous racial type. Until comparatively recent times they have been more or less completely isolated.

TABLE VII

VARIABILITY

(Expressed by the Coefficient of Variability (V) in Percent)

Measurement	Male			Female			Male and Female		
	Andamanese	Philippine Negrito	Naqada	Andamanese	Philippine Negrito	Naqada	Andamanese	Philippine Negrito	Naqada
Cranial Capacity	8.24	8.28	7.72	5.31	8.61	6.92	8.75	10.70	....
Greatest Length	....	3.07	3.24	....	3.80	3.10	....	4.34	....
Greatest Breadth	3.00	2.80	3.29	2.14	3.67	3.45	3.15	4.11	....
Basion-Bregmatic Height	3.77	4.26	3.98	2.56	3.67	3.66	3.95	4.39	....
Cranial Breadth-Height Index	4.24	3.55	4.72	2.26	3.80	4.73	3.74	3.83	....
Minimum Frontal Breadth	4.64	5.50	5.29	3.01	4.34	4.47	4.41	5.30	....
Bizygomatic Diameter	4.25	4.09	4.16	2.38	4.40	4.77	4.67	5.12	....
Basion-Nasion Length	4.57	3.78	4.88	2.81	5.14	4.68	4.03	5.15	....
Basion-Prosthion Length	5.50	5.84	4.84	4.17	6.41	5.09	4.78	6.41	....
Index of Alveolar Projection	2.78	3.79	....	3.38	4.44	....	3.36	4.09	....
Nasal Height	6.39	5.56	6.13	3.10	5.41	6.81	6.85	6.19	....
Nasal Width	6.61	8.71	7.89	5.20	7.32	7.28	6.81	8.42	....
Nasal Index	5.94	8.06	8.18	2.98	6.84	9.28	5.64	7.73	....
Orbital Width	3.65	4.55	4.97	3.53	5.69	5.30	4.47	5.36	....
Orbital Height	4.00	4.73	7.06	3.58	5.42	6.58	4.14	5.15	....
Orbital Index	35.0	5.44	6.76	4.48	5.00	5.94	4.84	5.40	....

An examination of Table VII will show that the theory is borne out by the facts. The Andamanese are considerably less variable throughout than either the Philippine Negrito or Naqada series. In the male groups the Andamanese are least variable in eight characters, intermediate in five, and most variable in only two characters. These two characters are nasal height and bizygomatic width. The rather large variability of bizygomatic width is apparently due to the inclusion of a few adolescent individuals who have rather narrow faces. Face width is known to be one of the last diameters of the head or face to reach adult proportions since it is apparently dependent somewhat on the eruption of the teeth. In a series of Indians this diameter was found to show a rather large annual increment up to the age of twenty-five years. In the female groups the Andamanese are the least variable of the three groups throughout.

Comparative Variability of the Groups.

	Male			Female			Both Sexes	
	Least Variable	Inter-mediate	Most Variable	Least Variable	Inter-mediate	Most Variable	Least Variable	Most Variable
Andamanese	8	5	2	15	0	0	14	1
Philippine	6	5	5	0	11	5	1	14
Naqada	2	6	7	1	5	9	..	..
Total Number of Characters	16	16	14	16	16	14	15	15

Perhaps less to be expected is the fact that the Philippine Negrito series is less variable than the Naqada series. In the male group the Philippine Negrito is least variable in six characters, intermediate in five, and most variable in five. In the female groups the Philippine Negritos are least variable in no characters since the Andamanese monopolize this position but they are intermediate in eleven characters and most variable in five. While the Naqada are undoubtedly a fairly homogeneous group, when we compare them with the Andamanese and the Philippine Negrito we find them least variable in only two characters in the male group, intermediate in six characters, and most variable in seven characters. In the female group they are least variable in one character, intermediate in five, and most variable in nine characters. When the sexes are combined the Andamanese are less variable than the Philippine Negrito in all characters except nasal height. These results may be summarized as follows:—

Since the Andamanese, the Philippine Negrito, and the Semang Negrito are almost universally regarded as representatives of the same racial type it will be of interest to compare the averages of the different measurements in the three groups. Unfortunately data on the Semang are scattered and sparse. The series of ten skulls described by Schlaginhaufen has been collected from five different sources. The averages cannot be taken as very significant. In the case of the Andamanese and Philippine Negrito, although the series are not as large as might be desired, some approach to an accurate comparison may be made. The averages are listed in Table VIII.

As mentioned before, the Andamanese have very small brain cases. Both the Semang and the Philippine Negrito surpass them in this respect. Consequently we should expect the gross diameters of the brain case to exceed in the Semang and the Philippine Negrito. Such is the case. Not only in the brain case but in every diameter recorded the Semang and the Philippine Negrito exceed the Andamanese. In Table IX I have compared the differences of the averages of the Andamanese and the Philippine Negrito with the variability of the averages ($\sqrt{e_1{}^2+e_2{}^2}$). It will be noted that the differences are positive in nearly every case and that they are of sufficient magnitude to be considered real mathematical differences. This too might be expected. If the Philippine Negrito originated from the same source as the Andamanese it must have been at some fairly early date. They are now widely separated and the one group has been isolated on their island home for some time, while the other has had an entirely different experience in a different

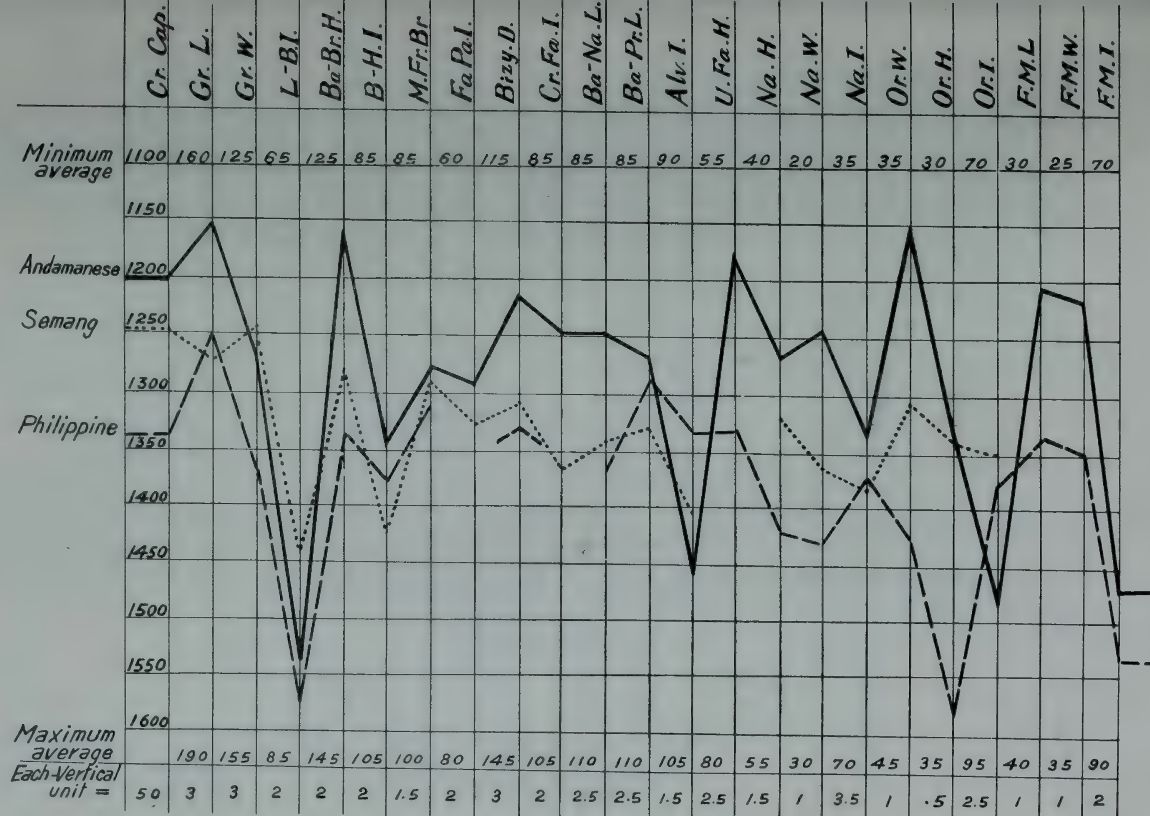

Fig. 1. Graphic comparison of the distribution of the averages of the entire series of Andamanese, Semang, and Philippine Negrito skulls in a scale representing the range of these measurements and indices in the various groups of mankind.

TABLE VIII

COMPARISON OF AVERAGES

Measurement	Male			Female			Male and Female		
	Andamanese Negrito	Philippine Negrito	Semang Negrito	Andamanese Negrito	Philippine Negrito	Semang Negrito	Andamanese Negrito	Philippine Negrito	Semang Negrito
Cranial Capacity	1269	1409	1338	1128	1219	1130	1199	1343	1248
Greatest Length	164.9	172.3	172.7	160.7	162.3	165.0	163.3	168.9	170.4
Greatest Width	136.1	143.7	134.7	131.8	135.9	131.0	134.4	141.0	133.6
Cranial Length-Breadth Index	84.3	83.4	78.1	81.0	83.9	79.4	82.5	84.0	78.9
Basion-Bregmatic Height	130.2	136.3	131.3	124.2	131.7	132.6	127.3	134.6	132.0
Cranial Breadth-Height Index	95.7	95.3	97.6	94.2	97.6	100.7	94.9	96.1	98.1
Minimum Frontal Breadth	92.2	92.3	90.4	89.2	89.5	91.3	90.7	91.2	90.7
Transverse Fronto-Parietal Index	68.1	....	70.8	67.8	....	68.1	67.8	....	69.5
Bizygomatic Diameter	124.6	131.3	128.6	117.7	123.0	125.0	121.8	128.8	127.4
Transverse Cranio-Facial Index	91.6	....	95.4	89.0	....	96.3	90.7	....	95.6
Basion-Nasion Length	93.4	99.5	97.0	90.8	93.7	98.0	92.3	97.8	97.3
Basion-Prosthion Length	93.4	95.4	96.5	92.5	90.7	96.3	93.0	94.0	96.4
Index of Alveolar Projection	100.3	96.3	99.4	101.8	98.1	98.3	100.9	96.9	99.1
Upper Anatomical Face Height	61.0	68.7	.....	56.6	69.9	.....	58.9	66.9	.....
Nasal Height	45.8	50.9	46.3	43.2	47.9	47.0	44.8	49.9	46.5
Nasal Width	23.3	27.2	24.5	22.5	25.0	27.0	22.9	26.6	25.3
Nasal Index	51.0	53.3	52.6	52.0	53.8	57.5	51.2	53.5	54.2
Orbital Width	36.7	42.2	39.1	35.7	40.4	39.0	36.2	41.6	39.1
Orbital Height	32.7	35.3	32.1	31.8	34.3	33.0	32.3	34.9	32.4
Orbital Index	89.0	83.2	81.8	89.1	84.6	84.2	89.3	83.8	82.6
Foramen Magnum Length	32.9	35.1	....	31.4	34.4	....	32.1	34.8	....
Foramen Magnum Width	28.0	30.1	....	26.7	29.5	....	27.4	29.9	....
Foramen Magnum Index	84.4	85.8	....	85.1	90.6	....	84.7	87.5	....

environment. The Philippine Negrito and Semang have probably been in contact with a greater number of racial types, at least in recent years. Perhaps the most surprising thing is that they are not more different from the Andamanese. While the differences that exist at the present time must be considered actual mathematical differences it is interesting to note the nature of these differences. In Fig. 1 I have noted the averages for these three groups in the form of a curve the basis of which is the range of the various measurements and indices as they have been recorded in racial groups. The vertical distances are determined not by the range of these measurements in individual cases but by the range of the average of these measurements in racial groups. They have been weighted by the extent of their variabilities. If a measurement like the average of the height of the orbit shows a range of only about five millimeters in mankind, a very slight difference, one millimeter, is more significant than a difference of one millimeter in length of cranium and so appears in the diagram. For the most part the direction of the curves is very similar and the differences constant. As previously stated they are variations in absolute size. The Semang differ from the Andamanese more than do the Philippine Negrito. Their brain cases are relatively considerably longer. Both the Semang and the Philippine Negrito have wider nasal apertures than the Andamanese. Quite characteristic of the Negrito as a whole is the value of the transverse fronto-parietal index which reveals the relationship between the narrow frontal region and the rather wide parietal region. The average is very low. Although the different methods of measuring the orbits make it difficult to compare them throughout, the indications are that the orbits are relatively high. The proportions of the foramen magnum also are nearly equal.

In conclusion, it may be said that while the three groups are quite different in some respects, on the whole, the differences are not as great as might be expected under the conditions. The data at hand do not seriously contradict the assumption that these three groups are quite closely related racially and the offspring of the same stock. Incidentally the question arises as to their relationship to the reported Negrito from New Guinea. Very little data are available. That a dwarfed negroid type exists in New Guinea cannot be further doubted after the reports of Van den Broek,[1] Williamson,[2] and Wollaston.[3] That they are Negrito in the

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[1]Van den Broek, 1915 (on p. 251 Van den Broek has included in his table of measurements on the nose the data of Chalmers which are obviously not comparable since Chalmers has recorded the breadth of nose of an individual 70 years of age as 9 millimeters!

[2]Williamson, 1912.

[3]Wollaston, 1912.

TABLE IX

COMPARISON OF DIFFERENCES OF THE AVERAGES OF MEASUREMENTS OF ANDAMANESE AND PHILIPPINE NEGRITOS WITH THE VARIABILITY OF THE AVERAGES

Measurement	Male		Female		Male and Female	
	A_2-A_1	$\sqrt{e_1^2+e_2^2}$	A_2-A_1	$\sqrt{e_1^2+e_2^2}$	A_2-A_1	$\sqrt{e_1^2+e_2^2}$
Cranial Capacity	140*	31.70	91	30.01	144*	26.38
Greatest Width	7.6*	1.07	4.1*	1.29	6.6*	.97
Basion Bregmatic Height	6.1*	1.40	7.5*	1.32	7.3*	1.04
Breadth-Height Index	-0.4	1.01	3.4*	.97	1.2	.71
Minimum Frontal Breadth	0.1	1.24	0.3	1.04	0.5	.87
Bizygomatic Diameter	6.7*	1.45	5.3*	1.56	7.0*	1.29
Basion-Nasion Length	6.1*	1.10	2.9	1.24	5.5*	.86
Basion-Prosthion Length	2.0	1.46	-1.8	1.81	1.0	1.09
Index of Alveolar Projection	-4.0*	.86	-3.7	1.39	-4.0*	.75
Nasal Height	5.1*	.77	4.7*	.70	4.1*	.61
Nasal Width	3.9*	.50	2.7*	.50	3.7*	.37
Nasal Index	2.3	.94	1.8	.98	2.3*	.69
Orbital Width	5.5*	.42	4.7*	.60	5.4*	.37
Orbital Height	2.6*	.37	2.5*	.49	2.6*	.30
Orbital Index	-5.8*	1.22	-4.5*	1.34	5.5*	.87

* = Denotes real mathematical difference.
A_1 = Average of Andamanese.
A_2 = Average of Philippine Negrito.

sense of being more nearly related to the Andamanese, Semang, and Philippine Negrito than to the Melanesian Negroes remains to be proved. Most certainly the skulls figured by Williamson are not Negrito, nor, I believe, are those of Pycraft.[1] Pycraft in the description of a series of skulls from Dutch New Guinea has seen fit to tear down the structure of craniometry and to substitute what he chooses to call morphological description. His arguments are far from convincing and in the end he leaves us only his own opinion that in the sixteen skulls described he finds eight different racial blends of six racial types. Few anthropologists would pose as such an expert. His Negrito element is characterized by conspicuous subnasal prognathism, the broad sweep of the dental arch, deep suborbital fossae, presence of a fronto-temporal articulation and a short wide ascending ramus of the mandible. These characters, together with the contours of the normae, are his criteria. In the contours figured

[1]Pycraft, 1916.

it is hard to read Negrito affinities. One of the skulls, which he characterizes as a Negrito blend, has a cephalic index of 68 and a nasal index of 46. It is interesting to notice that a majority of the skulls designated as Negrito are female and would naturally show a few of the infantile characters which are common in Negrito skulls but by no means confined to them. The data available at present are not adequate to determine whether in the case of the so-called Negrito type we are dealing with a single racial type or a series of local types. The entire Negrito group is worthy of more detailed study. The Andamanese, particularly, on account of their isolation are deserving of more serious study by anthropologists.

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THE FREQUENCY AND DISTRIBUTION OF SOME ANATOMICAL VARIATIONS IN AMERICAN CRANIA

BY

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CONTENTS.

LIST OF ILLUSTRATIONS.

Text Figures.

I. INTRODUCTION.

The term "anatomical variation" is used to designate the types of variations which are not expressible in measurements. Studies in craniometrical variations in American groups are seriously impeded by the widespread deformation of the crania. Roughly, this deformation is of three types: the fronto-occipital type, which results in a very much shortened and widened cranium and is prevalent in certain North Pacific Coast groups, in southeastern United States, and in certain parts of South America, notably Peru and nearby countries; the annular type, which results in a greatly elongated and constricted cranium, is prevalent among the Kwakiutl groups of the North Pacific Coast area and in a majority of the Peruvian and Bolivian groups; and the occipital type, which may be either intentional or accidental, is quite widespread, but is particularly prevalent in southwestern and southeastern United States. The result of such deformation renders all measurements of the brain-case futile and in a good many instances nullifies the significance of certain facial proportions, notably the width of the face, the frontal diameters, and possibly the proportions of the orbits.

For this reason craniometry has not been so useful in determining the relationships of American Indian groups to each other as it has in many other areas. Other methods must be employed. All that remains are the variations which I have called anatomical in contradistinction to the craniometrical. I am led to believe that when proper study is made of these anatomical characteristics considerable progress can be made towards indicating both racial and local affinities, but more particularly local affinities. In a measure, they parallel craniometric characters in frequency and distribution. One important difference must be stressed in interpreting them, however. While in a majority of craniometric characters relationship or non-relationships are usually indicated by similarities or differences in their mean or average values, a large number of descriptive characters are valuable only in a positive sense. For example, the presence of metopism in high frequency in two groups, closely located geographically, would undoubtedly be indicative of close physical relationship of the two groups. The absence of metopism in a third group would as unquestionably indicate that this group had not recently been in contact with either of the other two, but would not necessarily exclude it from close relationship at an earlier date before metopism had become characteristic. The value of metopism as an indicator of relationship would vary considerably in different areas and depend entirely upon the length of time that metopism had been characteristic

of the group or groups in question. For this reason, this method is not urged as a substitute for craniometry or anthropometry, but only as another possible method of approach when these two methods fail or as a supplementary method when they are applicable.

A serious objection to studies of these descriptive characters is the lack of standards which will insure comparable results.

However, the elimination of the personal equation seems possible to a large degree if we confine ourselves to certain characteristics which are either present or absent or which present certain easily recognizable stages of gradation. This involves a certain preliminary agreement of method of classification, since, to be strictly accurate, no characteristic lends itself wholly to such classification. I have selected such characters as the number of cusps on the lower second molar, the form of the lower border of the nasal aperture, the arrangement of the sutures in the region of the pterion, the presence or absence of the fossa pharyngea, the perforation of the tympanic element of the temporal bone, metopism, occurrence of the inca bone, the presence of sutural bones in various regions, and the frequency of mastoid division. Of these the following may be classified as the presence or absence group:—

A fifth cusp on the lower second molar
The fossa pharyngea
Perforation of the tympanic part of the temporal bone
Metopic suture
Inca bone
Sutural bones
Mastoid division

The remaining two, the form of the lower border of the nasal aperture, and the arrangement of the sutures in the region of the pterion, present some four or five more or less arbitrary types.

To take, for example, the number of cusps on the lower second molar, it is evident to any one who has examined teeth that the hypoconulid is not always conveniently present or absent. Some observers have attempted to designate its presence in terms of ⅓, ⅔, or even ⅙. I have found it impossible to make such estimates consistently and to obtain results comparable with a second series of my own observations or with the observations of another observer. The number of teeth examined for this character, the kinds of teeth examined, and the conception of the normal proportions of the hypoconulid in man all enter into and influence one's judgment in estimating fractional portions of such a small object. When I confined myself to noting what I more or less arbitrarily termed

the presence or absence of the hypoconulid, the results were more nearly comparable. A more minute classification seems to me to be exaggerated accuracy.

In recording the presence or absence of the fossa pharyngea I have studiously avoided designating all slight depressions in this region as pharyngeal fossæ. Only well marked cases were recorded. The same method was followed in recording the perforation of the tympanum. In noting metopism, only complete cases were recorded as metopic. A suggestion of metopism in the region from the nasion to the glabella is of very common occurrence in the Eskimo crania, but was not classified as metopism. Symmetry as well as size was considered in designating the inca bone present or absent.

In the case of the form of the lower border of the apertura pyriformis there is considerable difficulty encountered in some instances in distinguishing between a fossa and a sulcus, but if one adheres rigidly to the definition and is not influenced by general impressions, considerable uniformity of results should be expected. The principal difficulties arise in a few cases where the landmarks are ill defined. The arrangement of the sutures in the region of the pterion permits of fairly accurate results. A few borderline cases will undoubtedly fall now in one class and on second examination in another, but the changes more or less balance each other.

Many other characteristics beside those included in this paper were studied, but because the gradations were so minute and the error of observation so great I have not included them in this study.

Finally, I am aware that my material is inadequate for far-reaching conclusions and that the percentages of frequency would in many cases be considerably altered by the study of larger series; yet I feel that the series are of sufficient size to indicate the possibilities of tracing racial and local affinities by the study of anatomical characteristics where craniometrical data are inaccessible.

It is very important to note another possible source of error. It is possible that certain series of crania have been collected and selected on the basis of the presence of some of these characters. This is most likely to occur when there is an abundance of material to select from or when the collector is particularly interested in some one or two characters. In the collections of the American Museum of Natural History the possibility of such selection is encountered only in the Peruvian and Bolivian material. There is a possibility that with an enormous amount of material to select from, crania with such obvious peculiarities as metopism and the os inca were chosen more frequently than those in

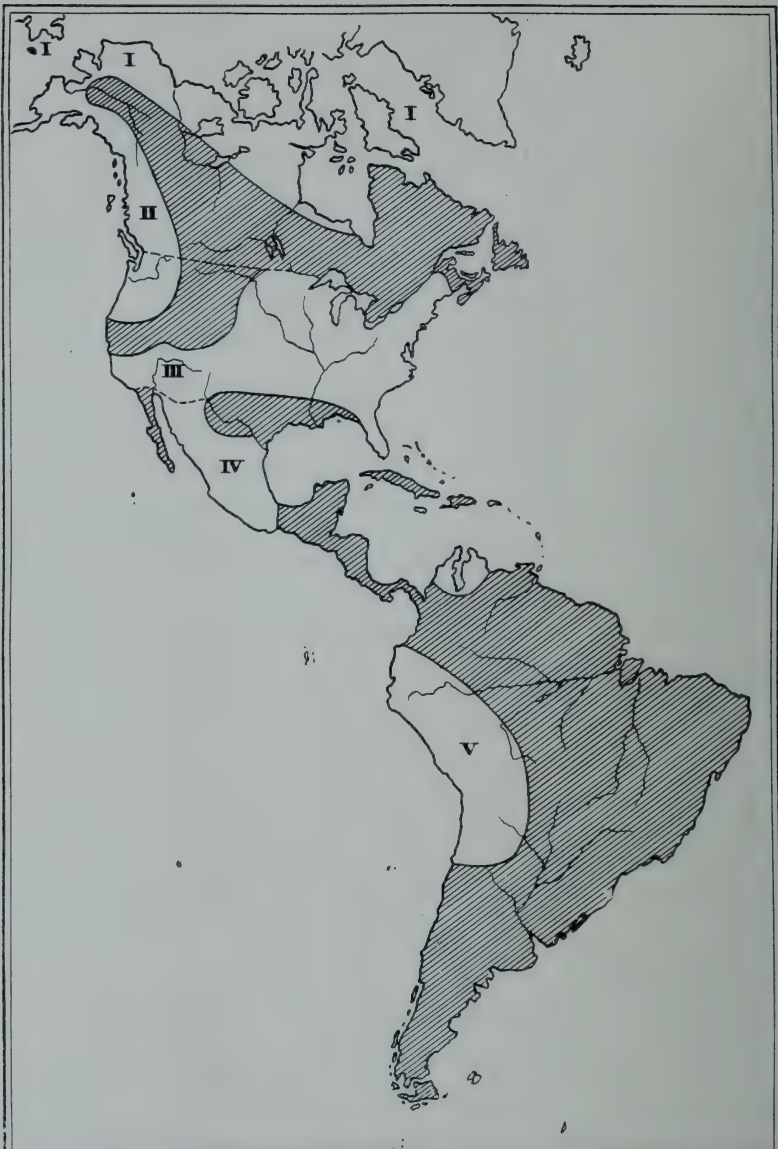

Fig. 1. Geographical Distribution of the Crania available for this Research. Shading indicates areas not represented in this study; numbered areas are represented by large collections as follows: I, Eskimo, II, North Pacific Coast; III, Southwest; IV, Mexico; V, Lake Titicaca.

which such features did not exist. Whether or not this actually happened I have no means of determining.

The map, Fig. 1, indicates the distribution of my material.

The data are grouped roughly in order of their racial and local significance. Such characters as the number of cusps on the lower second molar and the form of the lower border of the nasal aperture, which are fairly uniform throughout, I look upon as fundamental racial characters. The other characters which are more or less sporadic in occurrence I regard as local characters.

II. DIFFERENCES IN THE PATTERN OF THE LOWER SECOND MOLAR TEETH.

That the cusp patterns of the molar teeth in man vary considerably is well known. While this variability is sometimes the result of the formation of extra cusps or the fission of certain cusps, it is more often the result of the partial or total suppression of cusps that formerly were characteristic of man. While this reduction in the size and number of cusps is characteristic of all the molars it is particularly noticeable in the upper third molar and the lower second molar. The upper third molar has a tendency to become secondarily tritubercular through the loss of the hypocone. The lower second molar, on the other hand, is becoming secondarily quadritubercular through the loss of the hypoconulid.

With these two reduction processes in mind, I was particularly struck, in examining American Indian mandibulæ, by the fact that a very large percentage of the lower second molars were large, well-formed, five-cusped teeth.

While I did not have at hand sufficient material to make a detailed analysis of the condition typical of American Indians as a whole, I did have one particularly good series of mandibulæ of Tarascan Indians. This series is made up of forty-three mandibulæ of young adults showing little or no wear. As a contrasting group I had another series of thirty young adult crania from Southern India. This collection represents, in the main, a modified Mediterranean type although there are a few crania of the Veddah type.

The conditions in the two groups are quite different. In the collection of Tarascan Indians from Mexico the lower second molar has five cusps in 76.8 percent of the cases and four cusps in only 23.2 percent. The mandibulæ from Southern India, on the other hand, show five cusps in only 16.6 percent of the cases and four cusps in 83.4 percent. In the Tarascan group the fifth cusp (hypoconulid) in question is in a majority of cases large and well formed.

That the condition found in Tarascan Indians may be taken as representative of the condition in many American Indian groups I feel fairly certain. While, as I have said, I have insufficient material to point out the details of this distribution a random sample of 335 mandibulæ, coming from nearly all parts of the two American continents, gave the following results:—

5 cusps: 248, or 74.1 percent
4 cusps: 87, or 25.9 percent

Hrdlička (1916 and 1920 in correspondence), on the basis of a miscel-

laneous collection from the south and southwestern United States and Mexico, gives the frequency of 5 cusps as 21 percent, of 4 ½ cusps as 25 percent and of 4 cusps as 54 percent. But in sixty-seven lower second molars of the Sioux he observed 5 cusps in 68 percent; 4 ½ cusps in 6 percent, and 4 cusps in 26 percent. If we disregard Hrdlička's 4 ½ cusp class it will be seen that his Sioux group gave results almost identical with my Tarascan group.

Hrdlička's data suggest the possibility of a much higher frequency of the primitive five-cusped molar in some Indian groups than in others. The nature and significance of this difference in frequency must await further study on more extensive material.

Outside of America we have considerable comparative material. Allen, Cope, Topinard, Regnault, Vram, Martin, Schwerz, and de Terra have all contributed to the subject. From Topinard we take the following ing data:—

Number of Cusps on Lower Second Molar (after Topinard, 1892)

	Cusps: 6	5½	5	4½	4
European	1.7	...	10.0	30.0	60.0
Semite, Berber, Egyptian	...	...	13.1	13.1	75.8
Japanese, Chinese, etc.	6.9	...	37.9	10.4	44.7
Malay	...	...	29.8	8.9	61.2
Polynesian	...	...	22.2	25.0	52.8
Melanesian	1.0	3.1	33.0	14.4	48.5
African Negro	...	...	11.5	4.9	52.6
Miscellaneous	...	...	32.5	2.7	64.7

By far the most satisfactory treatment of the subject from an anthropological point of view is that of de Terra. Combining de Terra's extensive material with that of Schwerz, Martin, Hrdlička, and my own material I obtain the following seriation:—

Number of Cusps on Second Lower Molar

Group	Number	5	5.4	4	Author
Europe					
Early Swiss	26	7.7	....	92.4	de Terra
Alaman	20	10.0	....	90.0	de "
Römer Gräber	33	3.0	....	96.9	" "
North German	22	13.6	....	86.4	" "
Recent Swiss	31	6.2	3.1	90.7	" "
All recent European	281	16.0	1.1	82.2	" "
Hungarian	..	2.0	....	98.0	Schwerz
Lapp	..	15.0	....	85.0	Martin
Asia					
Malay (mixed)	46	26.1	17.4	56.5	de Terra
Battak	19	63.1	....	36.9	" "
Burmese	13	15.3	46.1	38.4	" "
Chinese	24	25.0	....	75.0	" "
Japanese	10	40.0	....	60.0	" "
Tamil	12	0	33.0	66.0	" "
Southern Indian	30	16.6	....	83.4	Sullivan
Australia	15	73.3	....	26.7	de Terra
Africa					
Negroes	104	33.6	3.9	62.9	de Terra
Negroes	..	34.0	....	66.0	Schwerz
Non-Negroid Africans	76	14.5	11.8	73.7	de Terra
American					
Tarascan	43	76.8	....	23.2	Sullivan
Sioux	67	68.0	6.0	26.0	Hrdlička
Southwestern Indians	..	21.0	25.0	54.0	"

While we need data from many groups not represented and also more adequate data from many groups now represented by small series, the material at hand indicates clearly that the so-called European or Caucasoid peoples are uniform in having a high percentage of cusp reduction in the lower second molar. Four cusps is the rule. Next in order of cusp reduction are the negroid groups and the yellow division of the mongoloid race. The Australian and the brown division of the mongoloid race (American Indians, Malays, and Indonesians) have a low frequency of cusp reduction. Five lower molar cusps is the rule.

III. THE APERTURA PYRIFORMIS.

The lower border of the nasal aperture presents a great variety of forms. These forms have been grouped by Macalister (1898) and others as follows:—

1. Infantile, or amblycraspedote type. In this type the lateral marginal edge remains as in the foetus and does not meet with the outward continuation of the paraseptal line. The persistence of the intermediate area gives a rounded interrupted appearance to the border. This type occurs in many South European and most mongoloid crania.

2. Anthropine, or oxycraspedote type. The lateral marginal edge and the paraseptal line are confluent making a sharp lower border which separates the nasal aperture from the alveoli. This type is common in European crania.

3. Prenasal fossæ, or bothrocraspedote form. This is an exaggeration of the foetal condition modified by the inward extension of the lateral margin above the incisor alveoli resulting in a scaphoid fossa obliquely placed.

4. Naso-alveolar sulcus, or oxygmocraspedote form. The lateral marginal edge is lost on the front of the lateral incisor alveoli. In consequence of this obliteration the floor of the nose is continued forward without any line of demarcation, from the facial surface of the alveolar process.

While these four forms are designated as types, it should be clearly recognized that they do not exist as separate types, but really represent recognizable phases of a normal frequency distribution. They are all developmental variants of a single form. There are a good many intermediate types and in many cases it is difficult to classify a given form. Even the two sides of the nasal aperture vary in form. My own experience would lead me to believe that the results of two different observers would not be strictly comparable. It should be possible, however, to obtain an agreement on the percentage of anthropine and non-anthropine forms.

Some idea of the distribution of this characteristic will be obtained from the table of Mingazzini (1891).

Group	No. of Cases	Anthropine	Fossæ	Infantile	Sulcus
Slav	65	50	8	2	5
Swiss	23	18	5	..	..
Italian	273	202	23	27	21
African	30	19	8	2	..
Argentine	5	1	2	2	..
Peruvian	19	7	5	3	4
Papuan	6	2	..	3	1
Fuegian	14	4	2	2	6
Australian	1	..	..	..	1
Siamese	4	3	..	..	1
Kanaka	2	..	..	1	..
Italian (insane)	141	118	9	6	8
Italian (criminals)	69	52	11	6	..

From the above it will be seen that the Europeans have a greater frequency of the anthropine form. About 80 percent approach this form. From my data, tabulated below, it will be seen that, considered as a group, about 65 percent of the American crania present the infantile form. This is true of a large number of the individual groups considered. In Kentucky, Bolivia, and Mexico we get a higher frequency of the anthropine form. The absence or low frequency of the anthropine type may be regarded as a characteristic of a majority of the Indian groups studied.

Types of Apertura Pyriformis in American Indian Crania.

Group	No. of Crania	Percent with Sulcus	Percent with Prenasal Fossæ	Percent with Infantile form	Percent with Anthropine form
Kentucky, May's Lick	28	....	....	39.2	60.8
Bolivia, Island of Titicaca	37	....	2.7	43.2	54.0
Mexico, San Simon	55	....	16.3	34.5	49.1
Mexico, Tlanepantla	24	....	16.6	37.5	45.8
Bolivia, Charassani	125	1.6	4.0	52.0	42.4
Mexico, Tarascan	122	6.5	7.4	44.2	41.7
Utah, Miscellaneous	23	8.7	4.3	47.8	39.1
Bolivia, Sicasica, Takana Chullpa	49	....	....	61.2	38.7
Mexico City	22	....	9.0	54.5	36.3
Mexico, Huichol	32	....	12.4	53.1	34.4
Bolivia, Huata, Chujun Paki	90	....	3.3	66.6	30.0
Bolivia, Sicasica, Churkoni Chullpa	54	....	1.8	68.5	29.6
Bolivia, Sicasica, Tama Tam Chullpa	172	....	4.0	66.2	29.6
Chinook	83	....	10.8	62.6	26.5
Bolivia, Sicasica, Kupa Pukio Chullpa	134	....	2.2	70.1	26.8
Peru, Coastal Area	57	....	7.0	66.6	26.3
New York	29	....	6.8	68.9	24.1
Kwakiutl, Koskimo	19	....	5.2	73.7	21.1
Eskimo, Hudson Bay Region	48	8.3	4.2	66.6	20.8
New Mexico, Pueblo	84	....	7.1	72.6	20.2
Kwakiutl, Miscellaneous	84	....	17.8	63.1	19.1
Peru, Marañon Country	21	....	4.7	76.1	19.0
Mexico, Tarahumare	44	4.5	9.0	68.2	18.2
Peru, Cachilaya	25	....	4.0	80.0	16.0
Oregon, Miscellaneous	26	....	....	84.6	15.4
Kwakiutl, Nimkish	30	....	10.0	76.6	13.3
Salish, Washington and British Columbia	123	1.6	14.6	72.3	11.4
Mexico, Cora	19	....	15.7	73.6	10.5
Eskimo, St. Lawrence Island and Siberia	43	2.3	16.3	72.1	9.3
Kwakiutl, Nootka	22	9.0	18.1	63.6	9.0
Eskimo, Alaska, Point Barrow	96	2.1	3.1	86.4	8.3
Haida	32	3.1	12.5	78.1	6.2
Utah, Grand Gulch, Basket Maker	96	2.0	9.4	82.3	6.2

Type of Apertura Pyriformis in American Crania. Distribution by Culture Area Groups.

		Sulcus	Fossa	Infantile	Anthropine	Total
Eskimo	No.	7	12	146	22	187
	Percent	3.7	6.4	78.1	11.7	
North Pacific Area	No.	6	62	325	77	470
	Percent	1.3	13.2	69.1	16.4	
California	No.	0	1	17	1	19
	Percent	0	5.2	89.2	5.2	
Eastern Woodlands	No.	0	5	32	15	52
	Percent	0	9.6	61.7	28.8	
Southeastern Area	No.	0	1	24	19	44
	Percent	0	2.3	54.5	43.2	
Plains Area	No.	0	2	1	5	8
	Percent	0	25.0	12.5	62.5	
Southwest	No.	4	18	173	36	231
	Percent	1.7	7.8	74.9	15.5	
Mexico	No.	10	43	177	125	355
	Percent	2.8	12.1	49.9	35.2	
Peru	No.	0	7	95	32	134
	Percent	0	5.2	70.9	23.8	
Bolivia, Huata Region	No.	0	4	92	59	155
	Percent	0	2.5	59.3	38.1	
Bolivia, Sicasica Region	No.	3	16	345	179	543
	Percent	.5	2.9	63.5	32.9	
Total American Crania	No.	30	171	1427	570	2198
	Percent	1.3	7.7	64.9	25.9	

IV. THE ARRANGEMENT OF THE SUTURES IN THE REGION OF THE PTERION.

The form of the pterion varies considerably in crania, but a given group usually presents a fairly uniform type of sutural arrangement. In descriptive work the practice has been to classify these arrangements as types approaching the form of a wide letter "H," a narrow letter "H," a letter "K," a letter "X", or with a frontal process on the temporal bone (less frequently a temporal process on the frontal bone), or with an extra element, the epipteric bone occurring in this region. These designations describe fairly accurately and aptly the forms of variation occurring in the region of the pterion. The "H" forms are the most frequent and the "X" form the least frequent. This statement holds true for American crania, at least. In a majority of the groups examined from 75 to 95 percent of the crania have the "H" forms of pterion. The variation most frequently met with, and of most interest, since it is the normal arrangement for some anthropoids and Old World monkeys, is the occurrence of the fronto-temporal articulation, or a frontal process on the temporal bone. Both sides should be considered in calculating its frequency. The method has been to count the occurrence of a fronto-temporal articulation on one side only as ½ in reckoning the percentage of occurrence. The following table from Bauer (1915) summarizes the results published, prior to his report:—

Number	Group	Percentage of Fronto-temporal Articulation
11,000	European	1.53
2,520	American	1.74
1,200	Asian	2.00
710	Mongolian	3.80
1,250	Malay	4.32
830	North African	5.66
422	Australian	9.00
787	Papuan	9.28
81	Ceylonesian	11.11
1,231	Negro	11.86
76	Baining	26.31
53	New World Monkeys	7.5
73	Gibbon	13.7
307	Orang-utang	33.6
374	Old World Monkeys	68.4
70	Chimpanzee	77.0
35	Gorilla	100.0

These data point clearly to the fact that the fronto-temporal articulation is of much greater frequency in African and Melanesian Negro crania and in Australians. It is constant in the gorilla and normal for the chimpanzee and the Old World monkeys.

My findings for American crania agree very closely with the above results. The fronto-temporal articulation is decidedly infrequent among these crania. Heading the list are found a majority of the Bolivian crania. They are well above the average in point of view of frequency. A few Kwakiutl and Mexican groups are slightly above the average also. The Peruvian, Northwest Coast, Southwest, and Eskimo groups show little or no frequency of this variation.

FREQUENCY OF FRONTO-TEMPORAL ARTICULATION AT PTERION IN AMERICAN CRANIA.

Group	Type of Deformation[1]	Number Examined	Frequency in Percent
Bolivia, Takana Chullpa	A	50	10.0
Bolivia, Chujun Paki	A	95	9.4
Kwakiutl, Koskimo	A	18	8.3
California, Miscellaneous	..	20	7.5
Bolivia, Tama Tam Chullpa	A	184	7.3
Bolivia, Belen Chullpa	A	7	7.1
Peru, Cuzco	A	17	5.8
Eskimo, Siberia, Indian Point	..	28	5.3
Mexico City	..	21	4.7
Mexico, Tlanepantla	..	24	4.1
Oregon	F.O.	26	3.8
Bolivia, Kupa Pukio	A	144	3.8
Eskimo, St. Lawrence Island	..	13	3.8
Peru, Cachilaya	A	32	3.3
Bolivia, Hank'o Kala	A	17	3.1
Bolivia, Lluchini Amaya	A	20	2.7
Bolivia, Churkoni Chullpa	A	57	2.6
Mexico, Cora	..	22	2.2
Kwakiutl, Nootka	A	23	2.1
Mexico, San Simon	..	50	2.0
Kwakiutl, Miscellaneous	A	86	1.7
New York	..	30	1.6
Haida	..	34	1.4
Kentucky, May's Lick	O	41	1.2
Mexico, Tarahumare	..	43	1.1
Utah, Basket Makers	..	92	1.0
Peru, Coastal Area	..	58	.8
Mexico, Tarasco	..	121	.8
New Mexico, Pueblo	O	76	.6
Bolivia, Charassani	A	144	.3

[1]Deformation.
O = Occipital flattening.
F.O. = Fronto-occipital compression
A = Annular deformation.

No Fronto-Temporal Articulation.

Colombia	9	A
Peru, Amazonas	21	. .
Peru, Sillustani	11	A
Kwakiutl, Bella Bella	13	O
Kwakiutl, Nimkish	34	A
Lillooet	5	. .
Salish, Saanich, British Columbia	10	F.O.
Salish, Bella Coola	19	F.O.
Salish, Thompson	26	. .
Salish, Nanaimo	12	F.O.
Salish, Kamloops	9	. .
Salish, British Columbia	32	F.O.
Salish, Washington	20	F.O.
Washington	22	F.O.
Tsimshian	8	O
Athapascan	7	. .
Florida	17	. .
Tennessee	8	O
Michigan, Illinois	14	. .
Ohio	9	. .
Arizona	16	O
Utah, Miscellaneous	23	O
Mexico, Huichol	30	. .
Eskimo, Hudson Bay	49	. .
Eskimo, Alaska	103	. .

Another variation of some frequency is the presence of the epipteric bone. To some extent it is correlated with the fronto-temporal form of articulation or at least occurs very frequently in groups having a high frequency of the fronto-temporal articulation. Bauer's table is as follows:—

Peruvian	6.0
Polynesian	9.3
Malay	10.3
Negro	10.9
Bavarian	12.7
Mongolian	16.0
Russian	16.8
Friesien	17.1
Andamanese	17.4
Vedda	21.1
Bavarian	22.4
Melanesian	25.9
Baining	27.6
Australian and Tasmanian	28.4
Swiss	28.4

Again the high frequency occurs in the Melanesian and Australian groups, but to these are added a number of Alpine European groups.

My method has been to count only as epipteric bones those with an area of at least 1 square centimeter. The occurrence on one side only has been counted as ½ a case. The Bolivian, Peruvian, a few Mexican groups, and several Salish groups head the list in point of view of frequency.

One's first impression is that the high frequency of epipteric bones is correlated with artificial or accidental deformation of the cranium, but the exceptions to the rule are sufficiently numerous to make this seem extremely doubtful. No individual correlation is possible since all or nearly all of a given group are deformed or undeformed. Since the ex-

FREQUENCY OF EPIPTERIC BONES IN AMERICAN CRANIA.

Group	Number Examined	Deformation	Epipteric Bones in Percent
Colombia	9	A	11.1
Bolivia, Belen Chullpa	7	A	7.1
Bolivia, Takana Chullpa	50	A	7.0
Mexico, Cora	22	..	6.8
Washington	15	F.O.	6.6
Peru, Cuzco	17	A	5.8
New Mexico, Pueblo	76	O	5.2
Eskimo, Hudson Bay	49	..	5.1
Salish, Washington	20	F.O.	5.0
Salish, Nanaimo	12	F.O.	4.1
Oregon	26	F.O.	3.8
Bolivia, Churkoni Chullpa	57	A	3.5
Peru, Cachilaya	34	A	3.3
Bolivia, Kupa Pukio Chullpa	144	A	2.7
Peru, Coastal Area	58	..	2.5
Kentucky, May's Lick	41	O	2.4
Mexico City	21	..	2.3
Peru, Marañon Country	21	..	2.3
Mexico, Tlanepantla	24	..	2.0
Bolivia, Charassani	144	A	1.7
New York	30	..	1.6
Bolivia, Chujun Paki	95	A	1.5
Mexico, Tarasco	121	..	1.5
Mexico, Tarahumare	43	..	1.1
Eskimo, Alaska	103	..	1.0
Kwakiutl, Miscellaneous	86	A	.5
Bolivia, Tama Tam Chullpa	184	A	.5

ceptions to the rule are both negative and positive I do not believe it possible to demonstrate that the two characters are related in the sense of cause and effect.

No Epipteric Bones.

Mexico	. .
Utah	O
Arizona, Miscellaneous	O
Massachusetts	. .
Illinois	. .
Michigan	. .
Plains Area	. .
Tennessee	. .
Florida	. .
Athapascan, Alaska	. .
Tsimshian	O
Yakima	O
Chinook	F.O.
Salish, British Columbia	F.O.
Salish, Kamloops	. .
Salish, Thompson	. .
Salish, Bella Coola	F.O.
Salish, Saanich	F.O.
Salish, Lillooet	. .
Kwakiutl, Bella Bella	O
Peru, Sillustani	A
Utah, Basket Makers	. .
Haida	. .
Mexico, San Simon	. .
Kwakiutl, Nootka	A
Bolivia, Lluchini Amaya	A
Bolivia, Hank'o Kala	A
Eskimo, St. Lawrence Island	. .
Eskimo, Siberia	. .
California	. .
Kwakiutl, Koskimo	A

V. THE FOSSA PHARYNGEA.

The fossa pharyngea, fovea bursea, or medio-basial fossa is a small oval depression in the ventral surface of the basilar part of the occipital bone. The major axis lies in the antero-posterior direction in the median line. It varies in depth from 2 millimeters to 7 millimeters. The width is approximately 4 millimeters on the average while the length varies from 5 to 11 millimeters.

The function or purpose of the fossa is not altogether clear. Anatomical text-books dismiss it with a sentence. Thompson (1917) writing in Cunningham (1917) says:—

> An oval pit, the fovea bursea or pharyngeal fossa, is sometimes seen in front of the tuberculum pharyngeum. This marks the site of the bursa pharyngea. . . . The origin and morphological significance of this pouch are not yet solved.

Romiti (1891) and Agostino (1901) claim that the fossa pharyngea is produced by a pharyngeal diverticulum either abnormal or accessory. This is in agreement with the opinion stated above. Perna (1906) concludes that the fossa pharyngea can be explained as a survival of that part of the median basilar canal which passes below the perichondrium on the ventral surface of the basilar portion of the occipital bone. The basilar part of the occipital bone ossifies like a vertebra and the fossa is the result of the non-ossification of the hypochordal bow element due to the position of the notochordal element of this region. I am not in a position to state the relative merits of the two opinions, nor am I altogether certain that they are necessarily contradictory.

However, its anthropological importance and utility are not wholly dependent on its physiological, morphological, or phylogenetic significance, but in great part on its relative frequency. According to all authors consulted, the fossa pharyngea is rather an uncommon structure both in man and other animals. Perna (1906) and Agostino (1901) give very little data on its frequency. Romiti (1891) found it five times in 700 crania (0.7%). He quotes Gruber as finding it 46 times in 4000 to 5000 skulls or in about 1 percent of the cases examined. Le Double (1903) records its frequency as 1.4 percent on the basis of 5000 skulls examined. Rossi (1891) is the only author to my knowledge who has attempted to segregate his material racially. His results follows:—

In 2911 European crania the fossa occurred 33 times or 1.31%.
In 801 non-European crania the fossa occurred 31 times or 3.87%.
In 240 Papuasian crania the fossa occurred 10 times or 4.16%.
In 159 Asiatic crania the fossa occurred 7 times or 4.40%.

The only conclusion one may draw from the above data is that the fossa pharyngea is of relatively rare occurrence and certainly not frequent enough to be of any great significance racially. It appears to be somewhat more frequent in Asiatic crania than in European crania. But even here the material is grouped in such a way that its significance is obscured. Bearing in mind the tremendous differentiation of mankind at the present time, material studied under such headings as European, Asiatic, and Papuasian can throw very little light upon our modern anthropological problems. Especially is this true in the study of such characters as the fossa pharyngea and other anomalous conditions. There is every reason to believe that these characters develop in individuals and are transmitted by inheritance. Their local distribution is of much greater significance than their racial distribution.

GROUPS REPRESENTED BY AT LEAST TWENTY CRANIA WHICH SHOW A RELATIVELY HIGH FREQUENCY OF THE PHARYNGEAL FOSSA.

Group	No. of Skulls[1]	Number with Pharyngeal Fossa	Percent with Pharyngeal Fossa
Basket Maker, Grand Gulch, Utah	97	26	26.8
Cora Indian, Mexico	21	5	23.8
California Indian (Hrdlička[2])	42	7	16.6
Huichol Indian, Mexico	32	5	15.5
Utah, Grand Gulch, deformed	22	3	13.6
Tlanepantla, Mexico	23	2	8.6
San Simon, Mexico	49	4	8.2
Tarahumare, Mexico	48	3	6.2
Total	334	55	16.4

I have not much non-American material at my disposal but the small amount available suggests that the fossa pharyngea occurs with a much greater frequency in some areas than in others. Out of five crania from New Hebrides two have the fossa pharyngea well marked. Two out of four crania from the Solomon Islands have it also. The number of cases are too small to permit any valid conclusions, but suggest a high frequency.

[1]Only crania or calvaria having the basilar part of the occipital bone in good condition are included in the totals throughout.

[2]Hrdlička, 1906.

Groups Represented by a Small Number of Crania but Showing a Relatively High Frequency of the Pharyngeal Fossa.

Group	No. of Skulls	Number with Pharyngeal Fossa	Percent with Pharyngeal Fossa
Papago	1	1	100.0
Clear Creek, Arizona	6	2	33.3
Tepecano, Mexico	4	1	25.0
Guatemala Indian	6	1	16.6
Williamson County, Tennessee	8	1	12.5
Illinois	8	1	12.5
Miscellaneous Plains Indian	10	1	10.0
Otomi, Mexico	11	1	9.0
Total	54	9	18.5

Groups Represented by a Large Number of Crania which Show a Low Frequency of the Pharyngeal Fossa.

Group	No. of Skulls	Number with Pharyngeal Fossa	Percent with Pharyngeal Fossa
Tarascan, Mexico	130	7	5.4
Hank'o Kala, Huata, Bolivia	17	1	5.3
Salish, Washington	24	1	4.3
City of Mexico	25	1	4.0
Chinook	92	3	3.3
May's Lick, Kentucky	45	1	2.2
Kwakiutl	87	2	2.2
Eastern Eskimo	50	1	2.0
Takana Chullpa, Bolivia	50	1	2.0
Peru, Coastal Region	58	1	1.7
Charassani, Bolivia	144	2	1.4
Tama Tam Chullpa, Bolivia	184	2	1.0
Kupa Pukio Chullpa, Bolivia	144	1	.7
Total	1050	24	2.3

Turning to the American material, I first became interested in the fossa pharyngea during the study of a group of Basket Maker crania from Grand Gulch, Utah. About 25 percent of the crania examined showed a larger or smaller fossa pharyngea. A little later I encountered it again in some Mexican Indian crania. Hrdlička (1906) also found it in his examination of California Indian crania.

Groups in which No Pharyngeal Fossae were Found.

Group	No. of Crania Examined
Chukchi, Siberia	7
Eskimo, Indian Point, Siberia	32
Eskimo, St. Lawrence Island, Bering Strait	13
Eskimo, Alaska (Point Barrow)	102
Athapascan, Alaska	8
Tsimshian	9
Haida	40
Yakima	15
Salish, Eburne, British Columbia	54
Salish, Kamloops	13
Salish, Nanaimo	13
Salish, Thompson	26
Salish, Bella Coola	20
Salish, Saanich, British Columbia	14
Salish, Lillooet	8
Kwakiutl, Nimkish	41
Kwakiutl, Nootka	23
Kwakiutl, Bella Coola	10
Washington, Miscellaneous	15
Oregon	27
California	21
New Mexico, Pueblo	86
New Mexico, Chaco Cañon	22
Colorado	6
New York	33
Massachusetts and Connecticut	6
Ohio, Madisonville	17
Michigan, Saginaw	7
Virginia	1
Georgia	1
North Carolina	1
Florida	25
Mexico, Yaqui	7
Mexico, Casas Grandes	11
Mexico, Zacateco	4
Colombia	10
Peru, Marañon Country	20
Peru, vicinity of Cuzco	18
Peru, Sillustani	11
Peru, Cachilaya	34
Island of Titicaca	64
Island of Cojata	2
Bolivia, Chujun Paki	95
Bolivia, Lluchini Amaya	18
Bolivia, Belen Chullpa	8
Bolivia, Churkoni Chullpa	55
Bolivia, Tiahuanaco	3
Cape Horn	3
Total	1079

Total Frequency of Fossa Pharyngea in American Crania.

Total Crania Examined	Total Crania with Fossa	Percent of Crania with Fossa
2517	88	3.5

I then decided to examine all the Indian and Eskimo crania in the collections of the American Museum of Natural History. The results are tabulated above. Considering the crania as a whole, the fossa pharyngea is not of very frequent occurrence in the American Indian and Eskimo. Of the 2517 crania examined it was present in 88 or 3.5 percent of the cases. This percentage is somewhat lower than that found by Rossi in miscellaneous collections of Asiatic and Papuasian crania.

When we consider the frequency in local groups the distribution becomes significant. All of the groups of high frequency are in the southwestern United States and Mexico. However, it was not found in the crania of the Pueblo peoples of New Mexico, Arizona, or Colorado. The distribution follows quite closely the distribution of the linguistic stocks tentatively grouped together as Uto-Aztecan. The crania in which it occurred with greatest frequency were moderately elongated with a cranial index averaging about 76 to 78. There is some overlapping in the distribution, notably in the case of the Otomi and Tarascan groups. This could undoubtedly be explained by contact and intermixture. On the other hand, the fossa was not found among the Yaqui or Zacatecan crania. In a few cases our material is inadequate to serve as a basis for valid deductions. This is true especially in the case of the Papago, Clear Creek, Arizona, and Otomi material. While our material as a whole may be taken as a fair sample in many areas, it is particularly deficient in the Plains area, Southeastern area, Plateau area, and in eastern and southern South America.

On the basis of the material at hand, it seems that the frequent occurrence of the fossa pharyngea is limited to that area of North America which is, or was, the home of the Uto-Aztecan linguistic stock. From the data at hand I can speak only of southern relationships. I have not enough Plains and Plateau material to determine the frequency in these groups.

At this point it would be well to recall the fact that our data can be interpreted in a positive sense only. Absence of the fossa would not necessarily bar any group from a fairly close relationship with those groups in which the fossa occurs.

It might be urged that this fossa is due to the presence of some environmental factor and non-indicative of relationship. But since this same Southwestern area is shared by short-headed Pueblo peoples, who do not show this peculiarity, this explanation seems inapplicable.

VI. THE PERFORATION OR DEHISCENCE OF THE TYMPANIC ELEMENT OF THE TEMPORAL BONE.

The perforation or dehiscence of the tympanic element of the temporal bone is undoubtedly a maldevelopment and due to a retardation of growth. It is commonly met with in all groups of crania of any considerable size examined. Yet, its very great frequency in certain American groups is worthy of record. It is usually bilateral in its occurrence, but when it occurred on one side only the frequency was recorded as ½. Hrdlička (1906) found it in 27.5 percent of the male crania from California and in 46.0 percent of the female crania. In nearly all of the Bolivian groups the frequency ranged from 40 to 50 percent. Next in order are the Peruvian groups. Following these are certain Mexican, Kwakiutl, Salish, and Southwestern groups. Only a few large groups show a total absence of auditory dehiscence.

Frequency of Perforated Tympanic Bones in American Crania.

Group	Number Examined	Percent with Perforated Tympanum
Peru, Marañon Country	20	55.0
Bolivia, Chujun Paki	94	52.1
Bolivia, Lluchini Amaya	20	50.0
Arizona, Clear Creek	6	50.0
Bolivia, Island of Titicaca	51	47.0
Bolivia, Charassani	144	46.5
Peru, Cachilaya	34	44.1
Bolivia, Churkoni Chullpa	56	42.8
Bolivia, Takana Chullpa	50	42.0
Bolivia, Kupa Pukio	139	41.7
Bolivia, Hank'o Kala	17	41.2
Washington, Yakima	8	37.5
Peru, Sillustani	11	36.3
Colorado	6	33.3
Bolivia, Tiahuanaco	3	33.3
Bolivia, Tama Tam Chullpa	184	32.0
Peru, Cuzco	17	29.4
Bolivia, Belen Chullpa	7	28.6
Utah, Deformed type	24	25.0
Mexico, Tepecano	4	25.0
Peru, Coastal Area	59	20.3
Colombia	10	20.0
Oregon, Columbia River Vicinity	27	18.5
Mexico, Tlanepantla	25	16.0

FREQUENCY OF PERFORATED TYMPANIC BONES IN AMERICAN CRANIA. (Continued)

Group	Number Examined	Percent with Perforated Tympanum
Eskimo, St. Lawrence Island	13	15.3
Kwakiutl, Koskimo	20	15.0
Mexico, Tarasco	130	14.6
Guatemala	7	14.3
Chukchi	7	14.3
Kentucky, May's Lick	42	14.3
Kwakiutl, Nimkish	37	13.5
Kwakiutl, Miscellaneous	89	13.4
Athapascan, Alaska	8	12.5
Eskimo, Hudson Bay	50	12.0
Haida	34	11.7
New Mexico, Pueblo	87	11.5
Mexico, Tarahumare	48	10.4
California	20	10.0
Mexico, Otomi	11	9.1
Salish, Washington	22	9.0
Salish, Kamloops	12	8.5
Salish, Nanaimo	12	8.5
Salish, British Columbia	39	7.7
Mexico, San Simon	56	7.1
Utah, Basket Makers	95	7.0
Salish, Thompson	29	6.8
Mexico, Huichol	33	6.0
Salish, Bella Coola	20	5.0
Eskimo, Indian Point, Siberia	32	3.1
New York	34	2.9
Eskimo, Alaska	107	1.0

TYMPANUM NOT PERFORATED.

Washington
Arizona, Miscellaneous
Papago and Pima
Massachusetts and Connecticut
Ohio
Illinois
Michigan
Plains Area
Tennessee
Florida, North Carolina
Virginia, Georgia

Tsimshian
Chinook
Salish, Saanich
Salish, Lillooet
Kwakiutl, Nootka
Kwakiutl, Bella Bella
Mexico City
Mexico, Yaqui
Mexico, Cora
Mexico, Zacatecan
Bolivia, Island of Cojata
Mexico, Casas Grandes

VII. METOPISM.

Metopism is the term used to designate in the adult an embryonic form of frontal bone in which the suture between the right and left halves of the bone is persistent. The condition is readily recognized and allows little opportunity for error of observation with different observers. Upwards of 40,000 crania from various parts of the world have been examined for this characteristic. Le Double (1903) summarizes the results on large series of crania representing the main racial types as follows:—

	Number Examined	Frequency in Percent
White race	11,459	8.2
Mongoloid race	621	5.1
Melanesian race	698	3.4
American race	1,191	2.1
Malay race	802	1.9
Negro race	959	1.2
Australian race	199	1.0

Martin (1914) gives a much more detailed table:—

Group	Number	Percent	Author
Ainu	60	0.0	Tarenetzky
Congo Negro	93	1.0	Bartels
Australian	199	1.0	Anutschin
North American	1127	1.1	Russell
Peruvian	458	1.1	Russell
Negro	959	1.2	Anutschin
American	426	1.2	Anutschin
Malay	422	2.8	Anutschin
Melanesian	698	3.4	Anutschin
Peruvian	565	3.5	Anutschin
Papuan	209	4.3	Regalia
Mongoloid	621	5.1	Anutschin
Bavarian	144	6.3	Ried
Slav	1093	6.4	Gruber
Swiss (Disentis)	250	7.1	Wettstein
Bavarian	2535	7.5	Ranke
East Prussian	804	7.9	Springer
Russian	210	8.0	Popori
European	10781	8.7	Anutschin
Tirolese	827	8.8	Frizzi
Hamburger	809	9.5	Simon
Parisian (Catacombs)	10000	9.9	Topinard
Parisian	1336	10.4	Papillault
Pompeian	93	10.7	Schmidt
Friesien	35	11.4	Barge
Portuguese	1000	11.8M9.3F	Machado
German	567	12.3	Welcker

There is a direct increase from the Australian race up through the negro and mongoloid types to the white race. From these data the deduction has been made that metopism is an advanced character and much more frequent in civilized races than in uncivilized groups.

The results are roughly in accord with those of Le Double. Russell (1900) reported on the American crania in the Peabody Museum, Cambridge, Massachusetts:—

Group	Number	Percent
Eskimo	52	.0
New England	68	2.9
Ohio and Tennessee	681	.8
California	160	1.9
Miscellaneous	260	.0
North America	1127	1.1
Peru	458	1.1
Total	1585	1.1

These data indicate a very low frequency of metopism in American crania. Anutschin found a little higher frequency in all his American material. In a series somewhat larger than Russell's (2496), but, for the most part, from different areas, I obtained quite different results. Russell's Peruvian crania are almost wholly from the coastal area and his results are only slightly different from mine for that area.[1] The average frequency is 7.6 percent. This in itself means little, however. The range and distribution of the frequency is of greater interest. My results are tabulated below:—

Frequency of Metopism in American Crania.

Group	Type of Deformation	No. of Crania	Number of Metopic Crania	Percent of Metopic Crania
Bolivia	A	3	1	33.3
Bolivia, Huata, Lluchini Amaya	A	19	5	26.3
Bolivia, N. Sicasica, Tama Tam Chullpa	A	184	46	25.0
Bolivia, Kupa Pukio Chullpa	A	144	34	23.6

[1]The tabulated results for this character show such an extremely high frequency and disagree to such an extent with Russell's data it is difficult to rid myself of the impression that my material has been somewhat highly selected on the basis of the presence of this character.

FREQUENCY OF METOPISM IN AMERICAN CRANIA (Continued).

Group	Type of Deformation	No. of Crania	Number of Metopic Crania	Percent of Metopic Crania
Colombia, South America	A	13	3	23.0
Bolivia, N. Sicasica, Churkoni Chullpa	A	56	12	21.4
Bolivia, N. Sicasica, Takana Chullpa	A	50	9	18.0
Bolivia, vicinity Charassani	A	144	25	17.3
Bolivia, Island of Titicaca	A	60	10	16.6
Bolivia, Huata, Chujun Paki	A	94	14	14.8
Alaska, Athapascan	..	8	1	12.5
Peru, Region of Cuzco	A	17	2	11.7
Salish, Bella Coola	F.O.	20	2	10.0
Koskimo	A	20	2	10.0
Salish, Washington	F.O.	23	2	8.7
Salish, Saanich, British Columbia	F.O.	12	1	8.3
Eskimo, St. Lawrence Island	..	13	1	7.6
Mexico, San Simon	..	54	4	7.4
Peru, Cachilaya	A	34	2	5.8
Nimkish	A	38	2	5.3
Peru, Lima and Coastal Region	..	58	3	5.2
Nootka	A	22	1	4.5
Mexico City vicinity	..	25	1	4.0
Oregon	A	27	1	3.7
Mexico, Huichol	..	32	1	3.1
Salish, British Columbia	F.O.	37	1	2.7
Kentucky, May's Lick	O	39	1	2.5
Kwakiutl, Vancouver Island	A	87	1	1.1
Tsimshian	O	9	0	
Haida	..	40	0	
Yakima	O	15	0	
Chinook	F.O.	92	0	
Salish, Kamloops	..	13	0	
Salish, Nanaimo	F.O.	13	0	
Salish, Thompson	..	26	0	
Salish, Lillooet	..	8	0	
Nootka	A	23	0	
Bella Bella	O	10	0	
Washington, Miscellaneous	F.O.	15	0	
Oregon	F.O.	27	0	
California	..	21	0	

Frequency of Metopism in American Crania (Continued).

Group	Type of Deformation	No. of Crania	Number of Metopic Crania	Percent of Metopic Crania
New Mexico, Pueblo	O	86	0	
Utah, Basket Makers	..	97	0	
Utah, Miscellaneous	O	22	0	
New Mexico, Chaco Cañon	O	..	0	
Arizona, Clear Creek	..	6	0	
Colorado	O	6	0	
New York	..	33	0	
Massachusetts and Connecticut	..	6	0	
Ohio	..	17	0	
Illinois	..	8	0	
Michigan	..	7	0	
Plains Area	..	10	0	
Tennessee	O	8	0	
Virginia	..	1	0	
Georgia	F.O.	1	0	
North Carolina	F.O.	1	0	
Florida	..	25	0	
Mexico, Yaqui	..	7	0	
Mexico, Tarascan	..	130	0	
Mexico, Cora	..	21	0	
Mexico, Tarahumare	..	48	0	
Mexico, Casas Grandes	..	11	0	
Mexico, Tlanepantla	..	23	0	
Mexico, Tepecano	..	4	0	
Mexico, Zacateco	..	4	0	
Mexico, Otomi	..	11	0	
Guatemala	O	6	0	
Peru, Marañon Country	..	20	0	
Peru, Sillustani	A	11	0	
Bolivia, Island of Cojata	..	2	0	
Bolivia, Huata, Hank'o Kala	A	17	0	
Bolivia, Belen Chullpa	A	8	0	
Tierra del Fuego	..	3	0	
Eskimo, Indian Point, Siberia	..	32	0	
Eskimo, Alaska, Point Barrow	..	102	0	
Eskimo, Eastern, Hudson Bay, Smith Sound	..	50	0	
Chukchi	..	7	0	
Totals		2496	190	7.6

Disregarding altogether the smaller series in which one case may make a large change in the percentage, we have a frequency ranging from 15 to 25 percent in six series from Bolivia in the regions of Huata near Lake Titicaca and Sicasica. All of the Bolivian crania excepting twenty-five from Hank'o Kala and Belen Chullpa are included in this group which head the list for a high frequency of metopism.

Certain Salish and Kwakiutl tribes in the North Pacific area stand next, but they are represented by a smaller number of crania and the percentage is of lesser significance. Two groups from Peru, Cachilaya and Cuzco, and one from San Simon, Mexico have a rather high frequency, but are also represented by a small number of cases only. The other areas represented by our collection are free from metopism.

I have indicated in the table the types of artificial cranial deformation existing in the groups examined because my first impression was that the deformation was to some extent responsible for the high frequency of metopism. It is easy to imagine that pressure exerted in the frontal region in accomplishing the annular and fronto-occipital type of deformation might interfere with or delay the closing of the frontal suture. The exceptions to this explanation are too great to permit any such explanation. The Chinook, represented by a series of ninety-two crania, show an extreme form of fronto-occipital flattening, but no metopism. The Kwakiutl from Vancouver, with the annular type of deformation, show only one case of metopism. On the other hand, four of the fifty-four undeformed crania from San Simon, Mexico, are metopic. Numerous other groups, represented by a smaller number of crania, are also exceptions to the above inference and make it clear that no such generalization is possible. It seems more probable that metopism is a local characteristic, for some cause or causes arising in a given group and transmitted by heredity. Its frequency is determined largely by its dominance and length of time since its appearance in the group.

VIII. THE INCA BONE.

Much interest has centered on the frequency of the os inca which received its name from its supposedly high frequency in the Inca crania. Later research has shown that many other groups have a higher frequency. The os inca is the term used to designate the upper or supra occipital portion of the occipital bone when this is separated from the rest of the bone by a suture. This bone manifests itself in a variety of forms, but is properly called the inca bone only when it is of considerable size and includes that portion of the occipital bone above the torus or inion. Frequently it is divided symmetrically into two, three, or four parts. The one part inca is of most frequent occurrence. Occasionally, only one or two parts of the composite inca bone appear. This is usually easily distinguishable from a wormian or sutural bone by its symmetry. Matthews (1893) gives the following data:—

Group	Complete and Incomplete Os Inca in Percent
Saladoan	6.81
Peruvian	6.08
American, not Peruvian	3.86
Negro	2.65
Malay and Polynesian	1.42
Mongolian	2.26
Papuan	.57
Caucasian in general	1.19
Caucasian in Asia	1.70
European	1.09
Melanesian	1.65
Australian and Tasmanian	.64

Compare this with Martin's (1914) table, which includes Russell's data:—

Group	Inca Bone Percent	Group	Inca Bone Percent
European	1.2	Peru	5.2
Malay	1.4	Old Bavarian	.1
Mongolian	2.3	Bavarian	.0
Negro	2.6	Mongoloid	3.7
Australian	.8	Malay	.0
Melanesian	1.6	Loango	2.1
Eskimo	4.0	Congo	2.0
New England	3.0	Bongo	.0
Florida	6.5	Egyptian (mummy)	3.7
Ohio and Tennessee	5.7	New Britain, New Ireland	10.0
New Mexico	0.0	Australian	.0
California	3.1	Old Peru	5.1
Mexico	3.6	Old Mexico	.0
North America	4.8		

While the frequency of the os inca in American crania is lower than the frequency of metopism, it is more widespread in its distribution. While my series from the North Pacific Coast area is small, there is a suggestion that the os inca is equally frequent here and in Peru. In Mexico, too, the frequency is fairly high in a number of groups. The Florida and Kentucky groups suggest a high frequency in the Southeastern area. The os inca is found to some extent in the Bolivian groups and Eskimo series. The Southwest, in so far as it is represented in this study, shows no instances of a high frequency of the os inca. Again, we cannot attribute the high frequency of the inca bone to the practice of deforming the cranium.

My own data are listed below:—

FREQUENCY OF THE INCA BONE IN AMERICAN CRANIA.

Group	Type of Deformation	Number Examined	Percent with Inca Bone
Michigan	. .	11	18.2
Salish, British Columbia	F.O.	39	15.3
Salish, Nanaimo	F.O.	15	13.3
Peru, Coastal Area	. .	58	12.1
Florida	. .	20	10.0
Kwakiutl, Koskimo	A	20	10.0
Salish, Saanich	F.O.	11	9.0
Peru, Sillustani	A	11	9.0
Peru, Marañon Country	. .	23	8.6
Mexico, Tarahumare	. .	48	8.3
Bolivia, Island of Titicaca	A	61	8.1
Kwakiutl, Nimkish	A	37	8.1
Kentucky, May's Lick	O	42	7.1
Eskimo, Indian Point, Siberia	. .	32	6.0
Tarasco, Mexico	. .	130	5.4
Bolivia, Tama Tam Chullpa	A	184	5.3
Mexico, San Simon	. .	56	5.3
Bella Coola	F.O.	20	5.0
Bolivia, Lluchuni Amaya	A	20	5.0
California	. .	22	4.5
Kwakiutl, Miscellaneous	A	90	4.5
Bolivia, Kupa Pukio	A	144	3.4
Thompson, Salish	. .	29	3.4
Chinook	F.O.	92	3.2
Haida	. .	34	3.0
Huichol, Mexico	. .	33	3.0
Bolivia, Chujun Páki	A	94	2.1
Bolivia, Charassani	A	144	2.1
Eskimo, Hudson Bay	. .	50	2.0
Bolivia, Churkoni Chullpa	A	56	1.8

Groups in which No Inca Bone was Found.

Group	Deformation
Athapascan, Alaska	. .
Yakima, Washington	O
Salish, Kamloops	. .
Bella Bella	O
Lillooet	. .
Salish, Washington	F.O.
Tsimshian	O
Papago	. .
Pima	. .
Colorado	O
Massachusetts and Connecticut	. .
Illinois	. .
Plains Area	. .
Virginia	. .
North Carolina	F.O.
Tennessee	O
Arizona, Clear Creek	. .
Arizona, Miscellaneous	O
Utah, deformed type	O
Utah, Basket Makers	. .
New Mexico	O
Washington, Columbia River	F.O.
Oregon	F.O.
Yaqui, Mexico	. .
Casas Grandes, Mexico	. .
Tepecano, Mexico	. .
Zacatecas, Mexico	. .
Otomi, Mexico	. .
Guatemala	O
Eskimo, Alaska	. .
Eskimo, St. Lawrence Island	. .
Chukchi	. .
Bolivia, Island of Cojata	. .
Bolivia, Tiahuanaco	A
Bolivia, Takana Chullpa	A
Bolivia, Hank'o Kala	A
Peru, Cachilaya	A
Peru, Cuzco	A
Colombia	A

IX. SUTURAL OR WORMIAN BONES IN THE LAMBDOIDAL SUTURE.

Sutural bones in the lambdoidal suture are of common occurrence and high frequency in a number of groups, particularly among American Indians. Martin's summarizing table (rearranged in the order of frequency) is as follows:—

Group	Percent	Group	Percent
Bongo	29.6	Egyptian mummies	7.6
Peru	21.5	Australian	7.6
Mexico	21.0	Loango	6.5
New Britain, New Ireland	18.0	Congo	6.5
Mongolian	14.2	California	4.7
North America	13.0	Bavarian	3.5
Mexico	12.3	Ohio and Tennessee	3.1
Florida	11.7	Eskimo	2.0
Peru	11.5	Old Bavarian	1.4
Malay	9.5		

My observations on American crania are tabulated below. A large majority of the groups have sutural bones in the region of the lambda. The number varies from one to thirty and the size from one-fourth of a square centimeter in area to twelve square centimeters. The greatest frequency occurs in the Bolivian groups. All groups from Bolivia of which I have fair samples show a very high frequency of this peculiarity. Next in frequency are the Peruvian and Southwestern United States groups. The Kwakiutl and Salish groups are also high in the scale. The crania from Mexico and the Eskimo crania have few or no sutural bones.

Frequency of Sutural or Wormian Bones in the Lambdoidal Suture of American Crania

Group	Type of Deformation	Number Examined	Percent with Sutural Bones
Utah, Miscellaneous	O	25	56.0
Bolivia, Churkoni Chullpa	A	56	53.5
Tennessee	..	8	50.0
Colombia	A	10	50.0
Bolivia, Kupa Pukio Chullpa	A	144	45.8
New Mexico	O	87	43.6
Bolivia, Takana Chullpa	A	50	42.0
Oregon	F.O.	25	40.0
Bolivia, Tama Tam, Chullpa	A	184	37.9
Bolivia, Hank'o Kala	A	17	35.3
Guatemala	O	6	33.3
Bolivia, Charassani	A	144	31.9
Utah, Basket Makers	..	100	31.0
Peru, Coastal Area	..	58	31.0
Bolivia, Lluchini Amaya	A	20	30.0
Kentucky, May's Lick	O	42	26.2
Arizona, Miscellaneous	O	16	25.0
Kwakiutl, Miscellaneous	A	90	23.6
Peru, Cuzco	A	17	23.5
Kwakiutl, Nimkish	A	37	21.6
Peru, Island of Titicaca	A	61	21.3
Bolivia, Chujun Paki	A	94	21.2
Mexico, San Simon	..	56	20.7
Salish, British Columbia	F.O.	39	20.5
Bella Coola, Salish	F.O.	20	20.0
Salish, Washington	F.O.	25	20.0
Mexico, Tarasco	..	128	19.5
Peru, Sillustani	A	11	18.2
Washington, Miscellaneous	F.O.	17	17.6
Arizona, Clear Creek	..	6	16.6
Kwakiutl, Koskimo	A	20	15.0
Florida	..	20	15.0
Peru, Cachilaya	A	34	14.7
Mexico, Tarahumare	..	48	14.6
Kwakiutl, Vancouver Island	A	15	13.3
Peru, Marañon Country	..	23	13.0
Tsimshian	O	8	12.5
Mexico City	..	25	12.0
Eskimo, Hudson Bay	..	50	12.0
Salish, Lillooet	..	9	11.1
California	..	22	9.0
Salish, Saanich	F.O.	11	9.0
Chinook	..	92	8.7
Thompson	..	29	6.8

Groups in which No Sutural or Wormian Bones were Found in the Lambdoidal Suture.

Group	Type of Deformation
Michigan	. .
Eskimo, Indian Point, Siberia	. .
Ohio	. .
Athapascan, Alaska	. .
Yakima, Washington	O
Salish, Kamloops	. .
Bella Bella	O
Papago	. .
Pima	. .
Colorado	O
Massachusetts and Connecticut	. .
Illinois	. .
Plains	. .
Virginia	. .
North Carolina	F.O.
Yaqui, Mexico	. .
Casas Grandes, Mexico	. .
Tepecano, Mexico	. .
Zacatecas, Mexico	. .
Otomi, Mexico	. .
Eskimo, Alaska	. .
Eskimo, St. Lawrence Island	. .
Bolivia, Island of Cojata	A
Bolivia, Tiahuanaco	A
Haida	. .
Huichol, Mexico	. .

In this instance, we get more clearly a correlation between a high frequency of sutural bones in the region of the lambda and deformation of the head. All the large groups of deformed crania stand high in the list, while the reverse is true of the non-deformed crania, with the exception of a few groups. If deformation may not be said to be the cause of the origin of these sutural bones, the indications are that it has been an aid.

X. OTHER SUTURAL BONES; MASTOID DIVISION.

Sutural bones in regions other than the lambda are relatively rare. However, a few American groups, notably the Salish and Kwakiutl of the North Pacific area and a few groups from Bolivia, show a fairly high frequency of sutural bones in the coronal suture. For the most part only one or two such sutural bones occur in any one cranium. The results are tabulated below:—

Frequency of Coronal Sutural Bones in American Crania.

Group	Deformation	Number Examined	Percent with Coronal Suturals
Salish, Nanaimo	A	12	16.6
Kwakiutl, Koskimo	A	20	15.0
Kwakiutl, Miscellaneous	A	87	9.2
Kwakiutl, Nootka	A	23	8.7
Bolivia, Kupa Pukio	A	144	6.2
New York	. .	34	5.6
Bolivia, Charassani	A	144	5.5
Salish, Washington	F.O.	24	4.1
Bolivia, Takana Chullpa	A	50	4.0
Oregon	F.O.	27	3.7
Bolivia, Churkoni Chullpa	A	56	3.5
Bolivia, Tama Tam Chullpa	A	184	2.7
Chinook	F.O.	92	2.1
Bolivia, Island of Titicaca	A	60	1.6
Utah, Basket Makers	. .	97	1.0
Bolivia, Chujun Paki	A	94	1.0

No Coronal Sutural Bones.

Chukchi, Siberia	Haida
Eskimo, Indian Point, Siberia	Yakima
Eskimo, St. Lawrence Island	Salish, British Columbia
Eskimo, Alaska	Salish, Kamloops
Eskimo, Hudson Bay	Salish, Thompson
Athapascan, Alaska	Salish, Bella Coola
Tsimshian	Salish, Saanich
Salish, Lillooet	Tarascan, Mexico
Kwakiutl, Nimkish	Cora, Mexico
Kwakiutl, Bella Bella	Tarahumare, Mexico
Washington	Casas Grandes, Mexico
California	Tlanepantla, Mexico
New Mexico	Tepecano, Mexico
Utah, Miscellaneous	Zacatecan, Mexico
Arizona, (all)	Otomi, Mexico

No Coronal Sutural Bones. (Continued).

Colorado	San Simon, Mexico
Massachusetts	Mexico City, Mexico
Ohio	Guatemala, Mexico
Illinois	Peru, Marañon Country
Michigan	Peru, Coastal Region
Plains Area	Peru, Sillustani and Cachilaya
Kentucky, Tennessee, Virginia	Bolivia, Hank'o Kala, Lluchini Amaya
Georgia, Florida	Belen Chullpa
Yaqui, Mexico	Tiahuanaco
Huichol, Mexico	

True bregma bones are also rare. Among the American groups examined I found the bregma bone present in only four crania, one each from the Marañon country group, Peru, from the Tarahumare, Mexican group, from the Churkoni Chullpa of Bolivia and from the Island of Titicaca.

Frequency of Bregma Bones In American Crania.

Group	Deformation	Number Examined	Percent with Bregma Bones
Peru, Marañon Country	..	21	4.8
Mexico, Tarahumare	..	48	2.1
Bolivia, Churkoni Chullpa	A	56	1.8
Bolivia, Island of Titicaca	A	60	1.6
All others	..	..	0

Russell's (1900) results show a similar low frequency:—

Group	Number	Percentage of Occurrence
Eskimo	52	1.9
New England	64	0
Florida	57	0
Ohio and Tennessee	468	1.1
New Mexico	22	0
California	159	0
Miscellaneous	62	1.6
Mexico	52	0
North America	884	.7
Peru (Ancon, Arica) etc.	449	.2
Total	1333	.5

Mastoid Division.

A true and complete division of the mastoid element of the temporal bone into its embryological components is of very rare occurrence. Of the crania examined by me it occurred only in the Eskimo groups and in a single cranium from Cuzco, Peru. While I have tabulated below only the cases of complete division it should be stated that traces of mastoid division are of very great frequency in Eskimo crania.

Frequency of Mastoid Division in American Indian Crania.

Group	Number Examined	Percent with Mastoid Divided
Eskimo, Hudson Bay, Western Greenland	50	8.0
Peru, Cuzco	17	5.9
Eskimo, Alaska	106	5.6
All others	..	0.0

XI. CORRELATIONS.

Correlations are of two types: group correlations and individual correlations. The first type may be regarded largely as accidental, or, more strictly speaking, as associations; while the latter is of greater anatomical significance. For example, we have an association of a high frequency of the pharyngeal fossa with an anthropine form of nasal aperture in the San Simon series. The two are not correlated in individuals. In the Basket Maker series from Utah we have a high frequency of the pharyngeal fossa associated with an infantile form of nasal aperture. In some groups we have an association of high frequency of five or six characters. In the Charassani group we have the anthropine form of nasal aperture very frequent as are also metopism, lambdoid sutural bones, perforated tympanum, and coronal sutural bones. In the Takana group we have a high frequency of epipteric bones, the fronto-temporal articulation, metopism, lambdoid suturals, coronal suturals, and perforation of the tympanum.

The following tables, however, show that there is no significant correlation of these characteristics in individuals.

Correlation Between Inca Bone and Metopism.
Tama Tam Chullpa, Bolivia (annular deformation)

	Inca or Interparietal	No Inca	Totals
Metopic	8	39	47
Non-metopic	8	129	137
Total	16	168	184

$r_2 = .53$

Correlation Between Perforated Tympanum and Inca Bone.
Tama Tam Chullpa, Bolivia.

	Tympanum Perforated	Tympanum Normal	Totals
Inca Bone	7	10	17
No Inca Bone	53	114	167
Totals	60	124	184

$r_2 = .20$

Correlation Between Perforated Tympanum and Metopism.
Bolivia, Island of Titicaca.

	Tympanum Perforated	Tympanum Normal	Totals
Metopic	1	9	10
Non-Metopic	23	28	51
Totals	24	37	61

$r_2 = —.76$

BOLIVIA, TAMA TAM CHULLPA.

	Tympanum Perforated	Tympanum Normal	Totals
Metopic	12	32	44
Non-Metopic	36	104	140
Totals	48	136	184

$r_2 = .04$

BOLIVIA, CHUJUN PAKI.

	Tympanum Perforated	Tympanum Normal	Totals
Metopic	9	5	14
Non-Metopic	41	39	80
Totals	50	44	94

$r_2 = .26$

BOLIVIA, KUPA PUKIO CHULLPA.

	Tympanum Perforated	Tympanum Normal	Totals
Metopic	17	16	33
Non-Metopic	46	65	111
Totals	63	81	144

$r_2 = .20$

BOLIVIA, CHARASSANI.

	Tympanum Perforated	Tympanum Normal	Totals
Metopic	13	11	24
Non-Metopic	56	64	120
Totals	69	75	144

$r_2 = .14$

CORRELATION BETWEEN METOPISM AND LAMBDOID SUTURAL BONES.
BOLIVIA, ISLAND OF TITICACA.

	Metopic	Non-Metopic	Totals
Sutural bones	2	10	12
No Sutural bones	7	42	49
Totals	9	52	61

$r_2 = .01$

Bolivia, Tama Tam Chullpa.

	Metopic	Non-Metopic	Totals
Sutural bones	27	34	61
No Sutural bones	18	105	123
Totals	45	139	184

$r_2 = .64$

Bolivia, Kupa Pukio Chullpa.

	Metopic	Non-Metopic	Totals
Sutural bones	15	47	62
No Sutural bones	20	62	82
Totals	35	109	144

$r_2 = .00$

Bolivia, Charassani.

	Metopic	Non-Metopic	Totals
Sutural bones	9	30	39
No Sutural bones	14	91	105
Totals	23	121	144

$r_2 = .32$

Correlation Between Lambdoid Sutural Bones and Perforated Tympanum.

Bolivia, Island of Titicaca.

	Tympanum Perforated	Tympanum Normal	Totals
Sutural bones	8	5	13
No Sutural bones	15	32	47
Totals	23	37	60

$r_2 = .54$

Bolivia, Tama Tam Chullpa.

	Tympanum Perforated	Tympanum Normal	Totals
Sutural bones	17	46	63
No Sutural bones	39	82	121
Totals	56	128	184

$r_2 = -.12$

BOLIVIA, TAKANA CHULLPA.

	Tympanum Perforated	Tympanum Normal	Totals
Sutural bones	6	12	18
No Sutural bones	15	17	32
Totals	21	29	50

$r_2 = -.29$

BOLIVIA, CHURKONI CHULLPA.

	Tympanum Perforated	Tympanum Normal	Totals
Sutural bones	11	9	20
No Sutural bones	12	24	36
Totals	23	33	56

$r_2 = .42$

BOLIVIA, KUPA PUKIO.

	Tympanum Perforated	Tympanum Normal	Totals
Sutural bones	27	39	66
No Sutural bones	39	48	87
Totals	66	87	153

$r_2 = -.08$

BOLIVIA, CHARASSANI.

	Tympanum Perforated	Tympanum Normal	Totals
Sutural bones	16 a	22 b	38
No Sutural bones	54 c	53 d	107
Totals	70	75	145

$r_2 = -.16$

NOTE: The coefficient of correlation (r_2) given is Yule's approximation to the true coefficient of correlation and is derived from the formula:

$$r_2 = \frac{ad - bc}{ad + bc}$$

in which a, b, c, d correspond to the values and the positions marked a, b, c, and d in the last table.

XII. SUMMARY.

I appreciate that my series in a large majority of instances is not sufficiently large to give accurate and final percentages; yet, I believe they are sufficiently large to indicate such frequency approximately and that the areas of high and low frequency are not accidental.

The most interesting results are naturally from the North Pacific area, Southwestern United States and Mexico, and Peru and Bolivia, since my material from these areas is greater in amount and more closely distributed.

Considering first the frequency of a frontal process on the temporal bone, we get a point of high frequency in the material from the Chullpa in the vicinity of Sicasica (Takana, Tama Tam, Belen and Kupa Pukio). This peak dwindles down in the material from the ruins of Lake Titicaca and the Peninsula of Huata, yet is of greater frequency here than in the other groups studied. There is a minor mode of considerable frequency in California and Mexico and one North Pacific tribe, the Koskimo, also shows this characteristic quite frequently. The high frequency of epipteric bones, lambdoidal sutural bones, and metopism show a similar distribution for the major modes. In the case of the epipteric bones there is again a minor mode of high frequency in Mexico and the North Pacific area. While these three characteristics have the same general distribution there is little or no individual correlation of them. It is rather an exception to find them all or any two of them in the same individual. Such cases as do occur are no more numerous than would be expected on the law of chance.

The perforated tympanum has the reverse distribution. It reaches its greatest frequency in the material from the ruins near Lake Titicaca and dwindles down towards Sicasica on the one hand and Charassani on the other.

The pharyngeal fossa has its area of greatest frequency in Utah and in that part of Mexico inhabited by the Uto-Aztecan peoples.

The inca bone is most frequent in the North Pacific Coast area among the Kwakiutl and Salish people. A minor peak of high frequency exists in the material from coastal Peru, the Marañon country, and Sillustani.

The infantile type of the lower border of the apertura pyriformis prevails in the American Indian as a group as it does also in mongoloid peoples generally. It persists most frequently in the material from Utah designated as "Basket Maker," in the Eskimo, the Indians from Oregon and Cachilaya, Peru.

The anthropine or distinctly human type of apertura pyriformis has arisen in several areas in America. The principal points of high frequency in the groups studied were the San Simon, Tlanepantla, and Tarascan material from Mexico, another in the material from the Island of Titicaca, diminishing in frequency north and south towards Charassani and Sicasica, respectively, and the more or less isolated series (so far as my material is concerned) from May's Lick, Kentucky.

The prenasal fossæ were not of very great frequency in any group, yet were most common in the North Pacific Coast material, notably that from the Kwakiutl, Salish, Haida, and Chinook groups and from those Southwestern groups in which we found a high frequency of the pharyngeal fossa: Basket Makers, San Simon, Huichol, Cora, and Tlanepantla groups.

In general, the distribution of the above-mentioned characteristics may be said to be as follows. The points of greatest frequency occur in groups located for the most part in close proximity to each other. The farther away from the mode we move geographically the lower the frequency. In a few instances we have minor modes in areas well removed from the point of the major mode geographically.

Our interpretation of this distribution will hinge somewhat upon our conception of the American Indian. I believe that the greater number of anthropologists who have studied the American Indian tribes agree that they all belong to the same race of mankind and that a majority of their fundamental characteristics are unquestionably mongoloid. They have in common coarse lank black hair, a yellowish brown skin, dark brown eyes, a poor development of hair upon the face, body and limbs, rather wide and massive faces, an intermediate nasal development, and concave shovel-shaped upper incisors. But going beyond these similarities we encounter quite a range of variability in several characters. The following anthropometric data illustrate this variability.[1]

[1]These seriations are given to show the variation in the range of the averages. The form of the curves resulting are not significant from a biometric standpoint since the grouping of our material has been to some extent accidental. Averages of tribes are represented. Since a dozen tribes may represent the same physical stock and one tribe may represent two physical types the resulting frequencies are not properly weighted. The form of the curve is also affected by the intensity of work done in certain areas.

Stature of American Indians (Males, Averages).

CM	
175	111
174	11
173	1111111
172	111111111
171	1111111111
170	1111111111111
169	1111111111
168	111111111111
167	1111111
166	1111111111111
165	11111
164	111111111111111
163	111111111
162	1111111111
161	1111111
160	1111111111
159	111111111
158	1111111
157	1111111
156	1111111
155	1111
154	
153	1

Averages of 177 groups.

Each (1) represents the average for a tribe or group and is placed opposite the centimeter nearest the average stature for the group.

Cephalic Index of American Indians (Males).

73	1
74	11
75	
76	1
77	11111
78	1111111
79	11111111111111
80	111111111111111111111111111111111
81	1111111111111
82	111111111111111111111
83	11111111111111
84	11111111111111111
85	11111111
86	111
87	111
88	111
89	11
90	1

Averages of 148 groups.

Nasal Index of American Indians.

63	11
65	
67	111
69	11
71	111
73	111111111
75	1111111111
77	11111111
79	1111111111111
81	111111111111
83	111111111111
85	1111111
87	111
89	
91	
93	
95	1

Averages of 85 groups.

Face Width of American Indians (Male).

MM	
130	11
132	11
134	1
136	11
138	11111
140	111111111111111111
142	111111111
144	11111111
146	1111111
148	1111111111111
150	1111111
152	1111
154	1
156	1111
158	
160	1

Averages of 84 groups.

In stature, they range from tribes approaching the pygmy types to the tall tribes surpassed by few groups of mankind. Although the range is considerable, the bulk of the tribes fall around the median. A somewhat similar distribution holds for head form as expressed by the cephalic index. A majority of the Indians have an intermediate average. The extremely long heads and extremely short heads are rare. Some of the latter are unquestionably due to artificial deformation. Nose form, as indicated by the nasal index, varies considerably. There is also consider-

able variation in the elevation of the nose from the face and in the contour of the profile. Face width is also quite variable, yet in most instances is greater than that of the European groups. The Eskimo, who are easily recognizable as a fairly distinct racial type (although also mongoloid in origin), form the upper limits of this distribution.

There is some disagreement as to the significance of this variation. Boas (1912) has suggested that this variation is largely the result of isolation, that as the population expanded over the New World it scattered out into more or less isolated local groups whose inbreeding soon differentiated varieties of head form and other features. Wissler (1917) has also apparently accepted this explanation and has made an attempt to designate the local groups. He limits the distribution of some thirteen local types. More recently, Hrdlička, who has had the greatest opportunity of examining Indian material both living and dead, has made the suggestion that there are two great types of American Indians, exclusive of the Eskimo and Athapascan groups, both of which he regards as fairly recent arrivals. However, he has not published his evidence for such conclusions in any detail and all discussion of the proposal must await the publication of such evidence. I believe all will agree that the Eskimo is a fairly distinct type, not likely to be confused with the Indian. From the published data it is also quite evident that the Southern Athapascan at least are quite different from their neighbors. The only questionable point in Hrdlička's suggestion is whether or not two types can be postulated which will include all other American groups. It is at least safe to say that we shall still have to call upon environmental influence to account for many apparently aberrant groups.

Until these types are more clearly indicated and defined, I prefer to regard the variations as more or less local variations from a single stock. The random distribution of the anthropometric characteristics already published and the lack of correlation or association of these characteristics in their distribution would seem to justify this stand at present. Stature, head form, nose form, and face width vary independently with very little tendency to form well-defined types extending over any considerable area. In fact, their distribution is similar to that found for the descriptive characteristics that are the subject of this paper. Such distributions point to a somewhat stable condition of the population for a very considerable time and, within reasonable limits, to a greater or less amount of isolation of regional groups.

The physical diversity in individual traits parallels, although it does not equal in extent, the linguistic diversity. In a large number of in-

stances these anatomical characteristics in their greatest frequency were confined to one or two linguistic stocks.

Another consideration is the phylogenetic significance of these characters. Many of them are unusual and uncommon in man but typical for certain anthropoids and other primates or even the lower mammals, reptiles and amphibians. For this reason, their occurrence in man has been regarded as the retention of a primitive trait and indicative of anatomical primitiveness. Such conclusions are open to objection. It is quite possible, from their very nature, for certain of these characteristics to be acquired secondarily. They can not be considered as a group but must be discussed separately. When we find, as we do, that the lower second molar tooth retains its primitive five-cusped pattern in a majority of the American Indians, as well as in other mongoloid types, it seems safe to assume that this is indeed the retention of a primitive characteristic. Almost the same may be said for the infantile type of the lower border of the apertura pyriformis. The anthropine or exclusively human type occurs only sporadically in mongoloid types. It is most logical to assume that the mongoloids are primitive in this characteristic. But, while it is logical, it is not as certain as is the primitive nature of the five-cusped lower second molar, for the anthropine type is but a developmental modification of the infantile type. By this I mean that the lower border of the nasal aperture is infantile in the early developmental stages. Any one of a number of disturbing elements during the formative period might result in a retention of the infantile type. However, as I said in the case at hand, with the widespread regional and racial distribution, I believe that this may be looked upon as a retention of a primitive character and not a secondary acquisition.

But, when we consider such characters as the frontal process on the temporal, the presence of epipteric bones, the fossa pharyngea, metopism, the presence of the inca bone, the perforated or incomplete tympanum, all of which are clearly represented in the embryonic and later development of the crania of all individuals, it is easier to believe that they may often arise secondarily as sports in groups in which they have not appeared in adults for centuries. They are, for the most part, the results of the non-union of embryonic elements that normally united, or the union of two embryonic elements in close contact which do not normally unite. Their sporadic and limited distribution would also seem to indicate this and eliminate them as racial characters, although it is conceivable that with opportunities for distribution one of these characteristics might become secondarily a racial characteristic.

Artificial deformation of the head has often been assigned as a causative factor for the appearance of such characteristics as metopism, the inca bone, epipteric bones, and other sutural bones. My data would seem to indicate that such conclusions are not warranted. Many groups that are not deformed have these elements in great frequency and many others that are deformed do not have these elements. The closest associations between deformation and the high frequency of extra elements occurs in the presence of lambdoidal sutural bones.

Finally, it seems clear that the true significance of such characteristics as have been dealt with here can only be determined when more detailed data are available for interpretation.

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25-8

ANTHROPOLOGICAL PAPERS

OF

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VOL. XXIII, PART VI

COMPARATIVE DATA ON RESPIRATION AND CIRCULATION AMONG NATIVE AND FOREIGN BORN MALES IN NEW YORK CITY.

BY

CLARK WISSLER.

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COMPARATIVE DATA ON RESPIRATION AND CIRCULATION AMONG NATIVE AND FOREIGN BORN MALES IN NEW YORK CITY.

By Clark Wissler.

Foreword.

The data upon which this study is based were gathered incidentally in the course of medical examinations conducted by Local Draft Board No. 129, New York City, of which the writer was Examiner-in-chief.

After recovering from the rush of the first draft, in which we were overwhelmed by the examination of a host of normal persons, it occurred to the writer that there offered an opportunity to collect data from normal individuals and correlate the findings. As the registrants passed through our hands it seemed that possibly some so-called symptoms might actually be normal variations and further that such racial characters as may prevail normally might have been smoothed out under the average conditions of American life, and lastly, that some endocrinological stigmata might be verified as such, with their correlations, or discarded. This was especially appropriate, as we were at that time entirely dependent on foreign authors for anthropological studies and scientific photographs of white men. The fact that we could examine only a relatively small number of registrants we sought to offset by the painstaking care and thoroughness of the examinations. Our district represented a typical segment of our urban population, preponderantly of the middle class, but it included both very poor and very rich. Here, coming directly to the American Museum of Natural History, where the Board met, was opportunity for studying *Homo Sapiens* in his environment. What could be more appropriate than coöperation in the study with the Department of Anthropology of that great foundation? So, when the writer suggested this plan to gather supplementary data, the staff of the Museum, from President Henry Fairfield Osborn down, heartily joined in placing at our disposal adequate quarters so that the extensive examinations required could be expeditiously performed by a large number of examiners working simultaneously, and also in detailing trained members of its scientific staff to assist in the examination. Acknowledgment for cordial support should be made to my fellow members of Local Board No. 129, Mr. Julius Henry Cohen and Mr. Benedict Erstein.

Finally, the writer wishes to acknowledge the coöperation of the following physicians and specialists, whose skill and intimate knowledge of their respective fields, guarantees the integrity of the data.

Dentists: Dr. David Kreisler, Dr. Joseph Levy.

Laryngologists and Otologists: Dr. William L. Gatewood, Dr. Henry L. Lynah.

Neurologists: Dr. S. Philip Goodhart.

Occulists: Dr. Martin Cohen, Dr. Francis Gulliver.

Orthodontists: Dr. B. W. Weinberger.

Physicians: Dr. Zama Felbstein, Dr. Meyer H. Freund, Dr. Carl Goldmark, Dr. J. P. Gould, Dr. Henry Mosler, Dr. Jesse Schwartz, Dr. Lewis M. Silver, Dr. A. R. Stern, Dr. Salo N. Weber, Dr. Benno Wronker.

Jesse G. M. Bullowa, M.D.

October, 1923.

CONTENTS.

LIST OF ILLUSTRATIONS.

Text Figures

Introduction.

During the late war the Museum building and its equipment were placed at the disposal of the Local Draft Board. This gave opportunity for the author of this paper and the members of his staff to assist in the physical and medical examinations. In 1918 Doctor Jesse G. M. Bullowa, the supervising examiner, as stated in the Foreword, suggested that the examining board individually and systematically note supplementary data. Accordingly, a schedule was drawn supplementing the regular examination. This was carried through, as circumstances permitted, until the examinations were discontinued at the termination of the war. Later on, some of the data secured were tabulated, forming the basis of this publication.

Extensive reports on draft data in general have been published by Major Albert G. Love and Doctor Charles B. Davenport.[1] Unfortunately, no account of ancestry was taken in the regular draft, for which amends were made by a geographical classification according to residence and then interpreting the geographical groups so segregated according to the dominant ancestry as revealed by the census. At best, this is a crude method. However, at the demobilization of our army special examinations were given 100,000 men at which time the ancestry and place of birth were recorded.[2] In the compilation of these statistics, however, no distinctions were made between the foreign and the native born, we have therefore thought it advisable to consider from that standpoint the small number of observations reported upon here. As a sample of our population they will, at least, suggest what could be done by following out this method extensively.

The supplementary examination conducted by us comprised observations under the following heads:—

1. Ancestry and nationality.
2. Examinations of the teeth and measurements on the jaws.
3. Measurements and observations on the head and body.
4. Circulatory and respiratory functions.
5. Finger and sole imprints.

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[1] "Defects found in Drafted Men" (*Statistical Information compiled from the Draft Records showing the Physical Condition of Men registered and examined in pursuance of the requirements of the Selective Service Act*, Printed for the Use of the Senate Committee on Military Affairs. Washington, 1919); "Physical Examination of The First Million Draft Recruits: Methods and Results" (*War Department, Office of the Surgeon General*, Bulletin 11, Washington, 1919); "Defects found in Drafted Men" (*The Scientific Monthly*, January–February, 1920); "Defects found in Drafted Men" (*Statistical Information compiled from Draft Records showing the Physical Condition of the Men Registered and Examined in Pursuance of the Requirements of the Selective-Service Act, War Department*, Washington, 1920).

[2] Davenport, Charles B. and Love, Albert G., "The Medical Department of the United States Army in the World War," (*Vol. XV, Statistics, Part 1, Army Anthropology, Based on Observations made on Draft Recruits, 1917–1918, and on Veterans at Demobilization*, 1919, Washington, 1921).

Since the subjects vary in their ancestral origin we may expect them to show both hereditary and cultural differences. No one doubts that a man inherits physical and mental characters from his parents and that there are real differences between national groups like the Irish, French, Italians, etc. Yet, we have next to no available data on the subject, at least no data that can be called scientific. Hence, as a fundamental part of this examination we called for a full account of the subject's ancestry to the third generation. In case he represented more than the third native-born generation, data were secured as to the number of generations born in the United States. Additional data concerning the social and cultural position of the subject were secured.

Race, Nationality, Parentage, and Age.

The tables for parentage (1–2) give us a detailed analysis of national and racial elements in the group. From the records of the 456 men examined, we see that 104 were foreign born, or approximately one-fourth. These citizens of foreign birth represent twenty-seven countries, to which may be added Jews of five nationalities. The Irish are far in the lead, comprising about one-fifth of the total.

The distribution for the parents of the foreign born indicates that they are of pure stock. In other words, when a foreign born citizen is met, it is reasonably certain that his parents and grandparents were born under the same nationality as he.

When we turn to the 352 native born we find that while 178 of them had native born fathers, 174 were sons of foreign-born fathers. The number of native born mothers is 205. When we regard the grandparents, the number of native born falls to 96. This we may anticipate that but a small fraction of the 172 native born can qualify as old American stock. Of the foreign born fathers the Irish are again in the lead, but if the distinction as to Jews be disregarded they do not exceed the Germans. The total of foreign born Jewish fathers is 65.

While the original intent in gathering the data was to correlate the various observations with each other and with racial characters, it is now seen that the cases are too few for an exhaustive analysis. Our foreign born subjects are far from a homogeneous group in terms of racial characters and the individuals comprising the same have lived under many different environments. This must be borne in mind when we come to interpret the results presented here.

Our groups can be further analyzed as to age (3). According to the requirements of the draft all the subjects fall into two main age groups: 18 to 23, and 32 to 37. It will be necessary to take these differences into account as the discussion proceeds.

Distinctions between the Foreign and the Native Born. The investigations of Boas[1] followed by Guthe[2] and Hrdlicka[3] seem to indicate changes in bodily proportions of children born of foreign parents, suggesting that the new environmental complex modifies growth. Anyway it seems advisable to tabulate our data with respect to ancestry as indicated by

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[1]Boas, Franz, "Changes in Bodily Form of Descendants of Immigrants" (*Reports of the U. S. Immigration Commission*, Washington, 1911, *Columbia University Press, 1912*).
[2]Guthe, C. E., "Notes on the Cephalic Index of Russian Jews in Boston" (*American Journal of Physical Anthropology*, Vol. 1, 213–223, 1918).
[3]Hrdlicka, A., "The Old White Americans" (*Proceedings, Nineteenth International Congress of Americanists*, 582–601, Washington, 1917.)

the place of birth. We have therefore divided our subjects into two main groups, foreign born and native born. The latter we have again subdivided according to parentage into foreign, native, and mixed groups. Thus, all whose fathers and mothers were born in the United States were placed in one group; those who had one parent of foreign birth in another, etc. A comparison of the data for each throughout the series of examinations will show what differences, if any, we may expect between the foreign and the native born as represented here.

One pertinent objection to this procedure is that we are disregarding national lines, which is true; the small number of cases, as we have said, precludes any other method of grouping. Yet, it will be noted that, in the main, the ancestry of the native born in this series is the same as that of the foreign born. Care was also taken to exclude the very few individuals of non-European origin. Thus, the treatment we have given the data should reveal differences between the native and foreign born of European stock, if such differences exist. It is because the respective national groups are represented about equally among our nativity groups that the data for each can be considered comparable.

Grouping by Occupation.

Each subject gave his occupation, the answers being specific. These we have grouped under seven arbitrary heads, as shown in the table, where the kind of work seemed comparable. We have plotted these from the United States parentage and foreign born groups only, since the differences between the groups are not great.

Grouping by Occupation.

	U. S. Parents		Foreign Born	
	n	%	*n*	%
Chauffeur	13	9	6	7
Clerical	47	33	11	12
Laborer	2	1	14	15
Mechanical	21	15	21	24
Professional	24	17	16	18
Salesman	28	20	18	20
Student	8	5	4	4
Totals	143	100	90	100

TABLE 1.

BIRTHPLACES OF THE FOREIGN BORN.

	Birthplace of Individuals Examined	Father	Mother	Father's Father	Father's Mother	Mother's Father	Mother's Mother
Armenia	1	1	1				
Austria	1	1	1	1	1	1	1
Austrian-Jew	5	5	3	2	2	1	1
Bohemia						1	
Bohemian-Jew						1	1
Brazil	2	2	1	1	1	1	1
British West Indies	4	4	4	3	3	2	3
Canada	6	3	4	2	1	1	1
China		1	1	1	1	1	1
Denmark	1	1	1				
England	9	9	8	9	7	4	5
France	3	3	3	4	3	3	3
Germany	6	8	8	6	6	7	6
German-Jew	7	5	6	4	5	5	5
Greece	1	1	1	1	1	1	1
Holland	1	1	2	1	1	1	1
Hungary	1	1	1	1	1	1	1
Hungarian-Jew	2	3	4	2	2	2	2
India	1						
Ireland	22	23	21	20	21	22	21
Italy	7	6	7	4	4	4	4
Luxemburg	1	1	1	1	1	1	1
Norway	1	1	1	1	1	1	1
Poland	1	1	1	1	1	1	1
Porto Rico	3	3	3	1	1	1	1
Roumanian-Jew	1	1	1	1	1	1	1
Russia	3	2	2	2	2	2	2
Russian-Jew	7	6	6	4	4	4	3
Scotland	4	2	2	2	3	2	2
South Africa	1		1				
Spain				1	1	1	1
Sweden	1	1	1				
West Indies	1	1	1	1	1	1	1
Totals	104	97	97	77	76	74	72

Table 2.
Birthplaces for Parents of the American Born.

	Father	Mother	Father's Father	Father's Mother	Mother's Father	Mother's Mother
Austria	1	1	1			
Austrian-Jew	10	3	5	6	2	3
Belgian-Jew					1	
Bohemian-Jew	3	1	2	2	2	2
Canada	3	1	1		1	1
Denmark	1	1	1	1	1	2
England	9	7	13	12	12	9
English-Jew						1
France	5	4	5	6	5	4
French-Jew	4		2	3	3	2
Germany	23	12	21	22	23	21
German-Jew	27	16	29	29	28	28
Holland (Jew)			2	2	1	1
Hungary	1	1	1	1	1	1
Hungarian-Jew	1	2	1	1	1	1
Ireland	52	45	51	52	52	49
Italy	2	2	2	2	2	2
Norway	1	1	1	1	1	1
Polish-Jew	2	1				
Roumania	1	1	1	1	1	1
Russian-Jew	17	13	14	14	12	12
Scotland	5	4	5	4	4	2
Sweden	1					
Switzerland	2		4	2	2	1
United States	178	205	96	86	86	93
United States (Jew)	1	29			1	4
Venezuela	1					
Totals	351	350	258	247	242	241

TABLE 3.
DISTRIBUTION BY AGE.

Yrs.	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
18	8	5	4	2	19
19	14	9	20	8	51
20	23	4	18	8	53
21	11	2	7	3	23
22		1	5	3	9
23	3	2	3	3	11
24	4	3	5	2	14
25	5	1	1	1	8
26	1	1	3	3	8
27	3		2	1	6
28	5	1	1	1	8
29	1	1	2	2	6
30	7	1	2	1	11
31	7	1	2	7	17
32	9	4	9	8	30
33	14	9	4	15	42
34	11	8	9	11	38
35	18	4	12	12	46
36	9	6	5	12	32
37	5	1	1	1	8
38			1	1	2
39		1	1		2
40	2				2
41	1				1
42	1		2		3
43		1			1
44	1				1
45	1		1	1	3
Totals	164	66	120	106	456

Respiratory and Circulatory Data.

Accompanying the required examination were a number of supplementary observations on health, function, etc., a few of which readily lend themselves to statistical treatment. Accordingly, we have tabulated these data under the same heads as in the preceding. In certain studies at the Nutrition Laboratory of the Carnegie Institution, pulse rate, blood pressure, and respiration rates have been studied with precision and continuity for a number of experimental squads of ten or more adult white males. Incidentally, the reports of these experiments furnish check data for our results.[1]

Table 4.

Respiration Rates.

Rate	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
14	1				1
16	1	1	2	1	5
18	19	10	20	6	55
20	55	21	34	27	137
22	37	14	24	29	104
24	22	4	16	20	62
26	6	2	1	1	10
28		1	2		3
n	141	53	99	84	377
A	21.06	20.755	19.869	21.523	
σ	2.220	2.307	2.364	1.942	
V	.105	.111	.118	.09	
Em	.187	.317	.124	.212	

Methods of Compilation. In the treatment of these data we have used the customary biometric methods as applied to variable data. These are sufficiently described elsewhere, but are seldom applied to medical data.

[1]Benedict, Francis G., Miles, Walter R., Roth, Paul, and Smith, H. Monmouth, "Human Vitality and Efficiency under Prolonged Restricted Diet" (*Publication 280, Carnegie Institution of Washington*, Washington, 1919).

Benedict, Francis G. and Cathcart, Edward P., "Muscular Work, a Metabolic Study with Special Reference to the Efficiency of the Human Body as a Machine" (*Publication 187, Carnegie Institution of Washington*, Washington, 1913).

Benedict, Francis G. and Slack, Edgar P., "A Comparative Study of Temperature Fluctuations in Different Parts of the Human Body" (*Publication 155, Carnegie Institution of Washington*, Washington, 1911).

Also, the point of view in this research is different from that in medical research where the individuals to be studied are selected according to health conditions, attention usually being given to the ill and the pathological. Again, in medical research the attention is given to cases. Our point of view is that of an anthropologist,—the study of groups taken as samples from given populations. Individuals, as such, are not considered, but a picture of the biological, or racial, group is sought with respect to isolated criteria. So we shall look upon the ancestral groups examined for military service, as samples of the populations from which they are drawn. Our chief concern will be to compare the aggregate status of the groups noted with respect to the medical observations previously enumerated.

Respiration Rates. The tabulation of the observed rates of respiration show but accidental differences between the ancestral groups, so we may consider them equivalent throughout.

The form of distribution has been commented upon by Julia Bell[1] as approximating an unsymmetrical type. Yet, the distributions in her data closely approximate those in our table, so we may suspect that this form of curve is the approximate picture of respiration rates in adult males of European ancestry.

The nutrition experiments just noted show that a squad of adult males varied in individual respiration rates as follows: lying down 11 to 15, standing 14 to 25, and after walking six minutes, 17 to 30.[2] Our data were taken standing and so are comparable to the 14 to 25 range, since we have 14 to 28. Careful observations on the breathing rate of 255 soldiers in Budapest are reported by Bell.[3] Repeated counts were made upon these subjects before rising in the morning. The averages were 15.84 ± 2.35 and the range from 9 to 25. All of our subjects were examined in the evening, 8 to 11 p.m.

Observations have been recorded by Hrdlicka[4] for American Indians as varying from 12 to 22 in males, from which he concludes that they are approximately equal to white males. Ferris[5] gives data for the Quichua Indians: n, 78, av. 17.2 ± 1.8. Yet one point should be noted, viz., the

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[1]Bell, Julia, "On Pulse and Breathing Rates and their Relation to Stature" (*Biometrika*, vol. 8, pp. 232–235, Cambridge, 1912).

[2]Benedict, Francis G., Miles, Walter R., Roth, Paul, and Smith, H. Monmouth, "Human Vitality and Efficiency under Prolonged Restricted Diet" (*Publication 280, Carnegie Institution of Washington*, Washington, 1919), 468–478.

[3]Bell, *op. cit.* 232–236.

[4]Hrdlicka, Ales, "Physiological and Medical Observations among the Indians of Southwestern United States and Northern Mexico" (*Bulletin 34, Bureau of American Ethnology*, Washington, 1908), 142.

[5]Ferris, H. B., "Anthropological Studies on the Quichua and Machiganga Indians" (*Transactions, Connecticut Academy of Arts and Sciences*, vol. 25, pp. 1–92, New Haven, 1921), 52.

rate fluctuates with bodily position, exercise, etc. Even mental excitement will modify it. Hence, caution must be observed in comparing data taken at different places and under uncertain conditions.

Vital Capacity. The readings were taken with a wet spirometer. Instructions were given the subject and a preliminary trial allowed before the actual test. An examination of the tables reveals large differences between the respective groups, almost too large to be considered accidental by the usual method of valuation.

The form of distribution seems to be symmetrical, but a certain amount of rounding off is apparent in reading the scale. These irregularities can be readily smoothed out by interpolation, if desired. This, however, will not materially modify the averages.

The highest readings, however, are those for the small group of mixed parentage. Yet the readings for those of United States parents exceed that for the foreign born by 155+. The order of rank is, mixed parentage, United States parents, foreign parents, foreign born.

However, we should be reminded that the variability in repeated tests of the same subject is believed to be large, and in consequence, introduces another undetermined factor into the equation expressing the range of the average for the group. Further, some observers consider that in spirometer readings a great deal depends upon the spirit with which the subjects enter into the test. For example, the more Americanized men may have come to the test with a greater sporting spirit than those of more immediate foreign antecedents. That this is a possible factor will appear in another part of this discussion.

Previous investigations with the spirometer indicate that readings may be modified by sex, dress, age, size, mode of life, health, etc.[1] Of these, sex and dress were eliminated as a disturbing factor. As to the mode of life and health no great differences are to be expected. There is, however, a slight difference in average age, the foreign born being older. It has been noted, however, that the readings vary with height and weight. According to Wintrich, as quoted by Whipple, "the average vital capacity for each centimeter of height is, from 8 to 10 years, 10 cc., from 16 to 18 years, 20.65 cc., and at 50 years, 21 cc. Schuster found the general correlation between vital capacity and height to be +.57, and that between the same capacity and weight to be +.59. It follows that in estimating the status of a given individual's vital capacity allowance must be made for his size of body as well as for his age."[2]

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[1]For a critical discussion of this test and a bibliography, see, Whipple, G. M., *Manual of Mental and Physical Tests* (Baltimore, 1914).
[2]Whipple, *ibid.*, 95–98.

TABLE 5.

VITAL CAPACITY.

Cc.	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
800			1	1	2
850					
900			1		1
950					
1000	1		2	4	7
1050	2		1		3
1100	1	1	1		3
1150					
1200	4	1	2	8	15
1250		1		2	3
1300	4	3	4	10	21
1350	1	1	1	2	5
1400	6	3	5	2	16
1450	1	1	3	2	7
1500	15	1	9	4	29
1550	3	2	1	3	9
1600	11		9	11	31
1650	5	1	2	1	9
1700	18	9	16	6	49
1750	5	2	3	5	15
1800	12	2	11	5	30
1850	3		2	1	6
1900	10	5	3	7	25
1950	3			1	4
2000	7	5	3	3	18
2050	2		1		3
2100	2	2	7	2	13
2150	1		4	1	6
2200	5	2		1	8
2250	2				2
2300	2	3	2		7
2350					
2400	1	1		1	3
2450	1	1			2
2500	2	1	1		4
2550					
2600		1			1
n	130	49	95	83	357
A	1724.23	1797.75	1667.36	1568.67	
σ	292.23	363.73	314.01	315.75	
V	0.17	0.21	0.19	0.20	
Em	25.62	51.96	32.21	34.65	

The statures of all the native born were approximately equal, but exceeded the foreign born by 2.5 cm. According to the above then, a correction of about 51.6 should be made, reducing the difference between those born of United States parents and the foreign born to 104+, and the corresponding difference from the mixed parentage group to 177+. These reduced differences are still large, though much less certain.

Chest Measurements. It is conceivable that if a real difference in lung capacity existed, similar differences should be observed in the dimensions of the chest and its expansion. So we turn to the data for the anterior-posterior and the transverse diameters and for inspiration and expiration.

For the diameters the values are:—

	n	A	σ	V	Em
United States parents	166	19.916	2.243	.1126	.174
Mixed parents	63	20.206	1.970	.097	.248
Foreign parents	109	20.358	2.612	.128	.250
Foreign born	104	20 509	2.090	.102	.205

It will be noted that these differences are too small to be certain and yet they are consistent in that the greater diameter goes with the degree of foreign birth.

The transverse diameter is as follows:—

	n	A	σ	V	Em
United States parents	156	27.865	2.088	.0749	.167
Mixed parents	66	28.045	2.345	.0836	.289
Foreign born	105	28.009	2.100	.0749	.205
Foreign parents	111	27.288	2.462	.0902	.234

These differences are certainly too small to be considered other than accidental. Yet, the foreign born are again near the maximum. It is therefore apparent that there can be no direct relation between the spirometer readings as noted and the diameters of the chest. Of course, this does not mean that within the respective groups there are no positive correlations for the two measurements.

The army measurements at demobilization also show small differences for the above diameters, but still the actual rank when grouped by nationality[1] was:—

[1]Davenport, C. B., and Love, A. G., "The Medical Department of the United States Army in the World War," (*Volume XV, Statistics. Part 1, Army Anthropology*, Washington, 1921), 210.

		Transverse Diameter
1.	Polish	29.22
2.	German	29.12
3.	Scotch	29.01
4.	English	28.87
5.	Irish	28.77
6.	Italian	28.76

The usual measurements for girth of chest at expiration and inspiration and the consequent mobility are presented in the table in inches. It will be noted that the differences in mobility, as they stand, are within the accidental range, except the United States parentage group and the foreign born, which approximates certainty. Also the rank is consistent as United States parentage, mixed parentage, foreign parentage, and the foreign born, whereas in the actual girth of chest the order is reversed.

The question may be raised as to the influence of occupation upon mobility, because it is probable that habits of posture and work will modify the record. Reference to our occupational table indicates that whatever advantage there is in this respect should lie with the foreign born, who are slightly more given to physical exertion. Yet, the foreign born show the lower reading. As to age, if we consider those over twenty-seven years only, the case stands:—

	n	A	σ
United States parents	100	3.138	0.90
Foreign born	78	2.697	0.75

Here again the foreign born are inferior to those of native parentage.

So it appears that we have a consistent result in all respiratory data in that, though the United States native group had a smaller chest, they blew more air into the spirometer and expanded their chests more.

TABLE 6.
ANTERIOR-POSTERIOR DIAMETER.

Cm.	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
14	2		2		4
15	3		1		4
16	7	3	4	1	15
17	17	2	5	7	31
18	14	7	14	7	42
19	21	9	12	16	58
20	30	15	21	23	89
21	29	14	19	22	84
22	25	3	13	14	55
23	11	6	5	7	29
24	6	4	6	4	20
25	1		2	1	4
26			3		3
27			1		1
28			1	2	3
n	166	63	109	104	442
A	19.916	20.206	20.358	20.509	
σ	2.243	1.970	2.612	2.090	
V	.1126	.097	.128	.102	
Em	.174	.248	.250	.205	

TABLE 7.
CHEST AT EXPIRATION.

Inches	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
28	5		1	2	8
29	14	2	6	4	26
30	13	7	14	10	44
31	28	9	19	10	66
32	31	7	26	25	89
33	24	16	21	23	84
34	23	9	11	14	57
35	11	3	6	10	30
36	4	3	4	5	16
37	4	2	2	5	13
38	2	3	1	3	9
39		1	2		3
40			1		1
41			2		2
42					
43		1		1	2
44		2			2
45					
46		1			1
n	159	66	116	112	453
A	32.157	33.666	32.466	32.938	
σ	2.191	3.504	2.496	2.358	
V	.0681	.104	.077	.072	
Em	.174	.431	.212	.223	

Table 8.

Chest at Inspiration.

Inches	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
29	2				2
30					
31	5	1	5	4	15
32	10	2	6	4	22
33	17	7	24	16	64
34	26	8	15	9	58
35	28	4	20	19	71
36	29	19	21	15	84
37	15	9	5	20	49
38	15	3	5	9	32
39	8	5	5	2	20
40	2	2	3	6	13
41	3	2	3	1	9
42					
43					
44			1		1
45		1		1	2
46		1			1
47		1			1
n	160	65	113	106	444
A	35.263	36.369	35.044	35.632	
σ	2.285	3.032	2.437	2.427	
V	.0647	.0834	.069	.068	
Em	.181	.376	.229	.236	

TABLE 9.
TRANSVERSE DIAMETER.

Cm.	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
23			5	1	6
24	4	1	5	3	13
25	20	5	15	8	48
26	21	12	21	16	70
27	24	14	21	16	75
28	29	10	15	18	72
29	23	11	12	16	62
30	17	4	4	13	38
31	11	3	7	9	30
32	5	3	2	4	14
33	1	1	1	1	4
34	1		2		3
35		1			1
36		1	1		2
n	156	66	111	105	438
A	27.865	28.045	27.288	28.009	
σ	2.088	2.345	2.462	2.10	
V	.075	.0836	.0902	.075	
Em	.167	.289	.234	.205	

TABLE 10.
MOBILITY.

Inches	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
.5				1	1
1.0	1		6	1	8
1.5	6	4	7	7	24
2.0	23	7	18	17	65
2.5	29	22	21	32	104
3.0	33	11	32	19	95
3.5	27	11	18	16	72
4.0	20	6	7	9	42
4.5	14	2	2	4	22
5.0	4	2	2		8
5.5	2		2		4
n	159	65	115	106	445
A	3.119	2.82	2.80	2.76	
σ	.912	.806	.903	.78	
V	.281	.284	.349	.207	
Em	.072	.099	.084	.086	

Pulse Rate. As required by the regulations of the Surgeon General's Office three counts of the pulse rate were taken: an initial count; a second after a dancing exercise of fixed period; and a third after two minutes of rest. In the tables we give the distributions for the pulse readings, rounded off by fives. So far as we know, no careful studies of the accuracy of pulse counting have been made. The usual method in clinical practice is to count for fifteen seconds and then multiply by four. This will result in rounding off as, 76, 80, 84, etc., without intervening values. Further, an error of one count will be recorded as an error of four counts. This undoubtedly introduces a large accidental statistical factor. However, in the data here used the method was to count for a full half minute, thus greatly increasing the accuracy. Yet, it appears that the observer tended to round off the record somewhat by reading to favorite numbers. So, from inspection, it seemed quite sufficient to tabulate the series in units of five beats.

One of the striking features in the records is the high readings for some initial counts. No doubt some allowance must be made for the mental stress of the examination and the serious nature of the whole situation. Influenza was raging at the time and some of the subjects were slightly ill, as will appear in the temperature tables. Yet, these conditions were the same for each group and so are not a disturbing factor in our comparisons. To this we shall revert under the head of Correlations.

Studies of the pulse rate in the Carnegie Nutrition Laboratory indicate great fluctuations even in a state of rest and relaxation, the variations in the same individual from day to day ranging in some cases from twenty to thirty beats. The rate is also greatly accelerated by vigorous exercise and is sensitive to changes in diet and ordinary mental work. All this introduces a variable complex into our records, but yet, other things being equal, should bear upon all our nationality groups equally.

The table shows the group rates, and taking the United States parentage group as the standard, we get the following:—

	Before	After	Rest
United States parentage	89.572	116.88	94.228
Mixed parentage	+1.428	—2.65	+0.160
Foreign parentage	+0.328	—2.74	—1.420
Foreign born	+0.112	—1.54	—2.740

All these differences are, it is true, within the range of accidental variation, but show a tendency for the foreign born factor to respond

less to exercise and to recover more rapidly, notwithstanding that the initial rate tends to increase with foreign birth.

Another way to express this relation is by taking the differences for each group, showing the acceleration of the rate.

	Increase by exertion	Increase after rest
United States parentage	+27.308	+4.656
Mixed parentage	+23.230	+3.388
Foreign parentage	+24.240	+2.908
Foreign born	+25.656	+1.804

Here again it appears that the foreign born are less accelerated by exercise and recover more rapidly. As in case of respiration this may mean a real resistance, or a mere mental attitude in that the foreign born entered less enthusiastically into the exercise. From personal observations during the examinations, the writer suspects the latter to be the true interpretation and that this applies equally to the respiration tests.

The age factor may operate here, as when we select out the older men, or all over twenty-seven years, we have the following:—

Pulse 2.	n	A	σ
Foreign born, over 27 years	68	116.7	21.5
Of United States parentage, over 27 years	77	118.2	20.2

It will be observed that in each case (Table 12) the rate for the older men is higher than for the younger. This is to be expected. Yet again, the rate for the foreign born is less. This, therefore, approaches a real difference.

The question of stature and weight should be considered, since there is a difference in size between the different nativity groups; but a careful treatment of data by Harris and Benedict[1] indicates a barely perceptible positive correlation in this respect. This would be negligible in our data. The same authors review the relation between age and pulse rate, showing that there is a slight decrease with age; but this need not be considered here since the averages for Pulse 1 are approximately the same.

[1]Harris, J. Arthur and Benedict, Francis G., "A Biometric Study of Basal Metabolism in Man" (*Publication 279, Carnegie Institution of Washington*, Washington, 1919).

TABLE 11.
PULSE 1.

Beats	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
60	1		1	1	3
65	4			3	7
70	7	6	12	18	43
75	7	4	5	8	24
80	22	4	15	7	48
85	24	10	13	5	52
90	27	5	15	12	59
95	18	9	14	14	55
100	13	3	12	8	36
105	4	1		3	8
110	6	3	6	7	22
115					
120	4	3	5	5	17
125					
130	1	2		3	6
135	1		2	1	4
140	1				1
n	140	50	100	95	385
A	89.572	91.0	89.9	89.684	
σ	13.454	15.33	14.177	17.176	
V	.150	.168	.158	.192	
Em	1.137	2.168	1.418	1.762	

TABLE 12.
PULSE 2.

Beats	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
65		1			1
70	3		1		4
75			1		1
80	1	2	1		4
85	6	2	2	5	15
90	3	2	6	6	17
95	5	3	7	4	19
100	13	5	11	9	38
105	4	4	7	5	20
110	18	4	6	11	39
115	11	1	5	6	23
120	21	10	25	18	74
125	8	4		2	14
130	11	7	8	10	36
135		1	2	1	4
140	6	3	2	3	14
145	7	2	5	2	16
150	4	1	1	2	8
155	1				1
160	2		3	1	6
165				1	1
170					
175					
180					
185				1	1
n	125[1]	52	93	87	357
A	116.88	114.231	114.14	115.345	
σ	20.952	18.762	18.762	19.026	
V	.179	.164	.164	.165	
Em	1.852	2.602	2.170	2.039	

[1]One case at 220 has been omitted from the table.

TABLE 13.
PULSE 3.

Beats	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
50	1				1
55					
60	2		2	1	5
65	2	1	1	1	5
70	2	1	4	12	19
75	5	1	2	3	11
80	13	4	10	8	35
85	19	8	9	8	44
90	17	10	19	18	64
95	20	9	14	6	49
100	10	6	11	11	38
105	4	1	4	1	10
110	11	4	6	6	27
115	2	1	1	2	6
120	7		3	3	13
125	1		1	1	3
130	2	2	2	1	7
135	1				1
140	2	1		1	4
145				1	1
150					
155					
160					
165					
170					
175					
180	1				1
n	122	49	89	84	344
A	94.221	94.388	92.808	91.488	
σ	15.588	14.213	14.036	16.553	
V	.1654	.151	.1512	.181	
Em	1.411	2.030	1.487	1.806	

A careful series of repeated observations were made in Budapest by Körösy in 1910 and reported upon by Bell.[1] In this case the subjects were soldiers and all records were taken in the morning before rising. The average of 255 cases was 64.2±8.48. The range was from 45 to 85 with two high readings. The form of distribution was slightly asymmetrical.

Turning now to our distribution, we may, for greater convenience, re-tabulate the data for the three successive pulse counts and smooth out the curves by using intervals of ten beats. The graphs for these

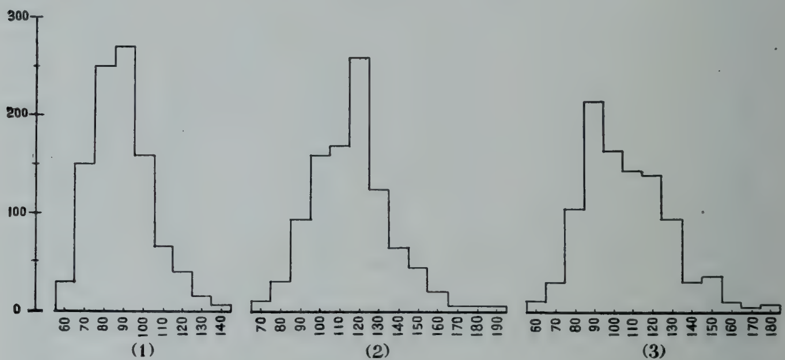

Fig. 1. Pulse Graphs, Table 14.

distributions are presented in Fig. 1. One first observes that the form of distribution for Pulse 1 is closely similar to the curve published by Julia Bell.[2] In fact the correspondence is so close that we may assume Miss Bell's curve to be a true picture of the pulse for a group of European males. We have in our data, however, an interesting presentation of what happens to the group when subjected to exercise. The immediate result of such exercise (Pulse 2) is to extend the base of the curve. Then, after a rest interval, the curve tends to return to its approximate initial form. Further, it seems that the curve for Pulse 2 tends to be the reverse of that for Pulse 1. In any case, the return after rest to the initial form is proof that we have here an approximate picture of the pulse for adult males.

Satisfactory data on the pulse rate for other than white subjects are not readily accessible. Hrdlicka maintains that the rates for certain American Indians are lower than for whites, the range being 44 to 78 for

[1]Bell, *ibid.*, 232–236.
[2]Bell, *ibid.*, 235.

Table 14.
Pulse Counts per thousand Cases.

Beats	Count 1	Count 2	Count 3
50	0	0	0
60	31	1	10
70	153	13	32
80	251	34	104
90	272	95	218
100	163	161	165
110	67	170	144
120	41	260	140
130	15	126	95
140	7	67	32
150		46	38
160		20	11
170		1	1
180		2	7
190		1	
200			
210			
220		3	3
Totals	1000	1000	1000

adult males.[1] As previously stated, the carefully studied white squads in nutrition experiments showed individual rates of 31 to 74 for adult males lying at rest and 50 to 89 when standing. The daily averages for the groups, standing, ranged from 61 to 76. Gould[2] in Civil War data gave the average for 503 Indians as 76.31. Hrdlicka[3] rejects this as an error on the ground that no pulse could be so high, but our data and the works just cited indicate that it can. Ferris[4] reports observations on Quichua Indian men: n, 74, average pulse 74.0 ± 9.6, with a form of distribution approximating our series for drafted men. This is not far from the Civil War Indian average. It is, therefore, still a question as to whether Indians have a slower pulse. The obvious sensitiveness of the pulse rate to diet, position, activity, mental stimulation, etc., requires that laboratory methods be used for group and race comparisons.

Some observations have been made upon Filipinos by Chamberlain and others. Two hundred natives gave an average of 79.1, another series of 536 males an average of 81.5. The effect of tropical climates is in dispute, but the evidence seems to indicate an increase of about ten beats per minute for whites of several years' residence in the tropics.

[1]Hrdlicka, *ibid.*, 141.
[2]*Investigations in the Military and Anthropological Statistics of American Soldiers* (1889).
[3]Hrdlicka, *ibid.*, 141.
[4]Ferris, *ibid.*, 52.

If this is correct, the Filipinos have a lower pulse rate than the Americans and Europeans examined by us, but the stress of the examination to which our subjects were subjected must be considered.

Blood Pressure. Blood pressure was taken in the customary manner and the readings recorded in fives. The ranges and frequencies for each group are given in the table. While it is true that the error in this measurement is known to be large, the forms of the distribution and the variabilities indicate considerable accuracy. The tables show that in some of the readings, the scale was read in tens, in others in fives. This will account for certain irregularities in the series. Yet in no case are the group differences large enough to be significant.

Researches in nutrition have brought to light some data upon the variability of blood pressure; for instance, it is found to vary with food shortage and slightly with exercise. Initial tests upon one experimental squad, normal conditions, indicated individual ranges of (S) 105 to 142; (D) 75 to 90. Considering that these were selected subjects, the range is comparable to that in our data. A test of one squad after twenty-four minutes of walking on the level, was made at intervals to nine minutes, individual variations of (S) 5 to 26; (D) 5 to 19. These ranges, it will be noted, are on the average, something less than the variabilities for our groups. Much greater ranges are reported by Faught.[1] Hence, notwithstanding the great number of observations made upon blood pressure readings in normal individuals, no one seems to have subjected these data to a rigid analysis by the methods used in biometric problems. It is, therefore, impossible to compare our series satisfactorily with the results obtained by others.[2]

The evidence that, on the average, blood pressure will rise with age is conclusive, but for reasons just stated no one can yet say what the approximate range of this correlation is. Woley's table, for example, shows a range of 120 to 135, between the ages of 15 and 60, an increase of 15 in forty-five years.[3] Oliver,[4] quotes life insurance data showing an

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[1]Faught, Francis Ashley, *Blood-Pressure from the Clinical Standpoint* (Philadelphia, 1916), 402–403.

[2]Since this was written there came to hand an important study by Alvarez, Wulzen, and Mahoney, (Alvarez, Walter C., Wulzen, Rosalind, and Mahoney, Lucille, J., "Blood Pressure in Fifteen Thousand University Freshmen" *Archives of Internal Medicine*, vol. 32, no. 1, July, 15, 1923) made on some fifteen thousand cases, taken in California. The average for men between the ages of sixteen and forty (6000 cases) is 128.9± 13.5. For the age group the averages range from 126.7 to 130.1 and the standard deviation from 12.2 to 14.1 It will be noted that these readings are slightly lower and a little less variable than our readings on drafted men. However, these investigators found that the blood pressure for both men and women was markedly lower in 1918 than in the following years, the low pressure being coincident with the influenza outbreak. Our readings, on the other hand, are approximately equivalent to those in California for 1919–20. If the same conditions prevailed among the population of New York City in 1918, our readings should be considered lower than what would have been found in 1920, otherwise the averages could be considered equivalent.

[3]Norris, George William, *Blood-Pressure, its Clinical Applications* (Philadelphia, 1917), 56.

[4]Oliver, George. *Studies in Blood-Pressure, Physiological and Clinical* (New York, 1916), 110.

increase of 16 in forty-five years. Faught[1] states that for each two years of life 1 should be added, but he does not give the basis for this conclusion. This would indicate that the increase for a year of age will range from one third to one half a unit for systolic readings.

Since our subjects vary considerably in age and, as will be seen in Table 3 fall into two age groups, it seemed desirable to regroup them. Those called in the second draft ranged from twenty-eight to forty-five years and, when taken alone, give the following results:—

28–45 yrs.	n	A	σ
Foreign born	68	131.2	17.2
United States parentage	84	131.3	13.9

It is thus apparent that when the age factor is equalized, the blood pressure for the different groups remains the same.

No comparative racial data have come to our notice.

Certain researches in tropical medicine in the Philippine Islands should be noted in this connection.[2] From the results so far published it appears that Filipinos have a lower pressure than Americans living at home, but not appreciably different from Americans residing in the Islands. For example:—

Filipinos (Chamberlain), 21–25 years	115.4
" (Concepcion and Bulatao), 21–30 years	113.5
Americans, P. I. (Musgrave and Sison), 25–40 years	113.0
" , U. S. (Woley), 21–30 years	122.0

Other data (diastolic and pulse pressure) compiled by these investigators are consistent with the foregoing, so that the blood pressure of the Filipinos appears to be the same as that for Europeans when subjected to the same environment. It is thus apparent that all racial comparisons in blood pressure must take into account the climatic variable. One point, however, seems established; viz., that Filipinos and Europeans give the same average under like conditions.

We may also note that the average for Hindus residing in Calcutta is given as 100 Hg., arterial pressure,[3] which is lower than for Europeans at home. In this again allowance must be made for climate. Recently there appeared some data on the blood pressures for Cantonese, 18–25 years, ranging from 100 to 108, D pressure from 68 to 78. As compared

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[1]Faught, *ibid.*, 401.

[2]Concepcion, Isabelo, and Bulatao, Emilio, "Blood-Pressure Picture of the Filipinos (*The Philippine Journal of Science*, vol. 11, section B, 135–149, Manila, 1916); Musgrave, W. E. and Sison, A. G., "Blood Pressure in the Tropics. A Preliminary Report" (*The Philippine Journal of Science*, Vol. 5, section B, 325–329, Manila, 1910); Chamberlain, Weston P., "A Study of the Systolic Blood-Pressure and the Pulse Rate of Healthy Adult Males in the Philippines" (*The Philippine Journal of Science*. vol. 6, section B, pp. 467–482, Manila, 1911).

[3]Oliver, *ibid.*, 115.

with other data these readings are low, but perhaps here also allowance must be made for local conditions.[1]

As to the American Indian the statement is made that no certain variations have been noted from the readings for whites up to the forty-fifth year of life, but that after that time Indians give lower readings than whites. However, no data are given by this author.[2]

In general, then, the suggestion is that the blood pressure for human kind is a constant, but more data are needed to prove the point.

TABLE 15.

BLOOD PRESSURE (S).

Pressure	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
95		1			1
100			1		1
105		1	1	1	3
110	10	5	4	9	28
115	2	2	3	3	10
120	38	10	17	20	85
125	11	5	6	9	31
130	27	12	22	25	86
135	8	3	8	4	23
140	20	3	17	16	56
145	3	2	3		8
150	9	3	3	2	17
155	1			3	4
160	3	4	6	2	15
165					
170	2	1		1	4
175				2	2
180		1	2	1	4
185			1		1
190			1		1
n	134	53	95	98	380
A	129.963	130.566	133.473	130.408	
σ	12.689	16.912	16.462	14.799	
V	.0976	.129	.1233	.1134	
Em	1.096	2.323	1.688	1.494	

[1]Cadbury, W. M. "Blood Pressure of Normal Cantonese Students" (*China Medical Journal*, vol. 37, pp. 715–725, Shanghai, September, 1923).
[2]Faught, *ibid.*, 163.

Table 16.

Blood Pressure (D).

Pressure	Born in United States			Foreign Born	Totals
	U. S. Parents	Mixed Parents	Foreign Parents		
40		1			1
45			1		1
50					
55					
60	7	5	4	2	18
65	6	1	3	1	11
70	17	9	20	16	62
75	12	4	6	4	26
80	40	13	27	26	106
85	11	3	6	3	23
90	23	12	15	24	74
95	6	1	2	4	13
100	11	3	5	7	26
105			1	2	3
110			3		3
115			2		2
n	133	52	95	89	369
A	81.015	78.942	81.105	83.033	
σ	10.344	12.0	12.728	10.247	
V	.128	.152	.157	.123	
Em	.897	1.664	1.305	1.086	

Temperature.

The readings for rectal temperature were taken with a clinical thermometer in the usual manner, and, like the other observations reported here, made by a specialist in medicine. The total distributions are shown in the table.

Table 17

Rectal Temperature Readings.

Degrees	Born in United States			Foreign Born	Total
	U. S. Parents	Mixed Parents	Foreign Parents		
98.0	3	0	0	0	3
98.2	2	1	4	1	8
98.4	3	0	0	3	6
98.6	1	2	1	2	6
98.8	17	9	4	18	48
99.0	37	20	23	28	108
99.2	24	9	9	10	52
99.4	15	10	9	9	43
99.6	12	6	3	3	24
99.8	7	3	2	3	15
100.0	21	6	9	11	47
100.2	4	1	3	1	9
100.4	5	0	1	1	7
100.6	1	1	2	0	4
100.8	1	0	1	0	2
101.0	1	1	2	1	5
101.2	1	0	1	1	3
n	155	69	74	92	390
A	99.3	99.3	99.4	99.2	
σ	0.57	0.48	0.65	0.53	
V	0.006	0.005	0.006	0.005	
Em	0.046	0.058	0.076	0.055	

Inspection of the distributions indicates, first, that the nodes for each group are the same, 99.0. The constancy of this is a certain indication of its validity for these groups. Next we observe that the form of distribution is asymmetrical and equally so for each subgroup. And in keeping with this, there is a secondary node at 100.0, again constant for all the subgroups.

These consistencies are strong evidence that we have in the table a true sample of New York City males at the period of examination. One notes that the high readings are quite evenly distributed among the subgroups, so all were subject to the same conditions. The coincidences of the nodes and ranges at once banish the possibility of racial differences in these groups, but to meet the conventional requirements of such research we have calculated the averages as shown. The maximum difference is less than three times the error of the average, too low to be significant.

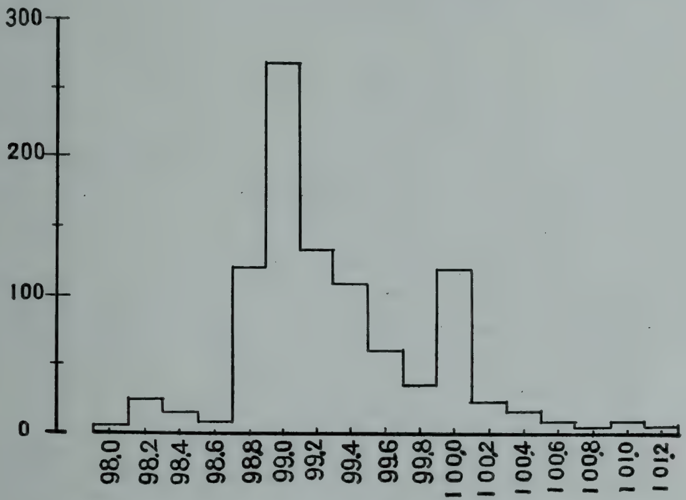

Fig. 2. Temperature Graph on Basis of a Thousand Cases.

Returning now to the consideration of the distributions, it may be objected that the node at 100.0 is due to the well-known habit of rounding off in reading the scale in the thermometer. Thus Fig. 2 shows the relation of these nodes to the total curve. It is reasonably certain that they are exaggerated by rounding-off, but still the form of the curve is such that the actual nodes would be expected at the same points. So, taking into account the fact that these readings were taken with great care, we regard the evidence as favoring the existence of two nodes.

The import of this would be that we are dealing with two separate series, one for normal temperature and one for a type of illness.

Inspection of the plotted curve (Fig. 2) indicates a sharp rise at each node. The two parts of the curve are so strikingly alike, that one is led to assume that the nodes represent two quite different levels of bodily

temperature. In other words, we suspect that there are two distributions in one.

The first of these may be designated as the normal series, the node to which is 99.0, and the individual range from 98.0 to 99.8.

The average rectal temperature is given as 98.96, which is approximately the first node in our series. Unfortunately, we have not found in the literature of the subject a comparable series of rectal readings for a group of men selected at random, but note should be taken of a few contributions. For example, a careful study of bodily temperature by Benedict and Slack[1] demonstrates that the rectal reading is the most constant and the best index to the temperatures for other parts of the body. Yet, the rectal reading will vary with the depth of insertion up to 6 cm. In addition, there is a perceptible variation in bodily temperature with the taking of food, position of body, exercise, etc. Age and size may be a factor also, but as reviewed by Hrdlicka[2] these differences are barely perceptible in children and tend to vanish in the adult. Yet, as his conclusions are based upon sub-lingual tests, less constant than rectal tests, they are not strictly comparable to our data.

In general, then, what literature we have consulted suggests that our first node and its part of the curve is an approximate picture of the rectal temperature in a normal group of males going about their daily work and regarding themselves as in good health. Further, all of our examinations were made between eight and eleven p.m.

At this point it may be well to note that the period during which these readings were taken coincided with the influenza outbreak of 1918. One may then suspect that the second node defines a curve which is a picture of a group with influenza. The average reading for this group would be approximately 100.14+. Yet other factors must be considered. As a try out we segregated all cases with a temperature of 100+ and found them as follows:—

	Foreign Born	Foreign Parents	Mixed Parents	U. S. Parents	Totals
Heart and lungs normal	10	14	7	16	47
Bronchitis and influenza	3	2	0	3	8
Heart defects	7	3	3	9	22
Lung defects	0	1	0	1	2
Tuberculosis	0	1	0	0	1
					80

[1] *Ibid.*
[2] *Ibid.*, 142.

Thus for more than half of these high temperature readings no cause can be assumed from the record; of the remainder, exactly two-thirds are associated with heart defects and irregularities, most of them very slight and usually merely rapid action. If then we should throw out these 33 cases having other defects of heart and lungs, the form of the series would not be greatly modified because we found no correlations between these defects and degree of temperature. The suggestion is, however, that slight increases in temperature tend to accompany heart defects, but the number of cases we have is too small to give definite results. As the table shows, influenza was observed in but few cases, yet for all that, it may have been the cause of half the total cases with high temperatures.

However, the interpretation of this series goes beyond our problem. The suggestion is, however, that the correct way to arrive at a true picture of a state of influenza would be to make extensive examinations in schools or industrial organizations when the disease is at its peak.

Our next problem is to determine the approximate average of our normal series. If we take out the abnormal series, the average will be slightly lowered, approximately 99.06. Thus, the first node is the approximate average for the first series. It is well to note, however, that the foregoing corrected average is 0.10 higher than the assumed standard of 98.96.

Finally, as to subgroups, or racial differences, it is clear that nothing of the kind can be established for these data, neither in the normal series, nor in the abnormal group.

Racial comparisons have been made by Hrdlicka upon Indians and whites. His tables show the same ranges as for our readings, but he claims a slightly lower temperature for Indians. Yet his differences range from 0.7 to 0.2, and the maximum difference for our group is 0.7. As we have noted, this is not quite twice the probable error of the average; hence, it is doubtful if Hrdlicka is justified in assuming a real difference for whites and Indians.

Summary. While the number of observations are too small to be given positive value, their consistency points to the probable outcome of further investigations along this line. It is not only suggested that the fundamental functions and processes herein recorded are equal for all European stocks, but for all human kind under similar environments and procedure. Yet, this should be taken as tentative until more data are available.

As samples of adult males selected at random from our population these results must be considered. Rarely do we find in medical literature comparable data. The tendency for the types of distribution, here shown to be constant, indicates a new approach to an understanding of the normal group. To date, no one seems to know just what to expect as to temperature, pulse, blood pressure, etc., in the population at large. Yet, this problem is approachable, as we have shown.

Correlations.

So far we have treated our measurements separately without considering their possible relations. For example, it is believed that a high temperature is accompanied by a rapid pulse, but no one knows to what degree these coincide. Since both temperature and pulse are highly variable, we may expect that their correlations in individuals will vary also. In biometrics, techniques have been devised for calculating the average correlations for such functions in individuals taken at random. Thus, for any given pair of functions, observations, or dimensions, a coefficient (r) of relation can be calculated ranging from 0 to 1. The reliability of these coefficients increases with the number of cases, the number we have being too low for final conclusions. Yet, since we have been able to find but a single attempt to correlate medical observations of this kind, it has seemed worth while to make approximate calculations for the preceding data.

Pulse Rate. One may, for example, ask, What are the chances that a low initial pulse will also be low after exercise? Or, to what degree will the individuals examined hold their ranks in the group? This can be determined by correlation, the complete data for which is given in the table (p. 299). In this case we find the coefficient of correlation to be +0.78, a high degree of relation for variable phenomena. In other words, the person with a low initial pulse was also relatively lower after exercise. Hence, on the average, the acceleration caused by exercise is constant for all.

To check this finding, we calculated all of the possible correlations for the three pulse counts:—

All males 18 to 27 years

	Cases	r
Pulse 1 and 2	163	+0.73
Pulse 1 and 3	164	+0.78
Pulse 2 and 3	163	+0.86

TABLE 18.

CORRELATION OF INITIAL PULSE RATE WITH PULSE RATE TWO MINUTES AFTER EXERCISE.

Two minutes after exercise	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	Totals
Initial pulse																				
60	1																			1
65			1	2			1													4
70			1	1	5	4	4	1						1						17
75					2	2	1	1	3	1										10
80						2	8	3	9	2										24
85				1	1		3	6	5	5	1	1	1							24
90							2	3	12	2	3		2							24
95							2		2	8	6		1		1					20
100					1			1	4	4	3	2	2	1	1					19
105									2			2				1				5
110									1			1			1		1			4
115																1				1
120												2			4		2			8
125											1									1
130																	1		1	2
Totals	1		2	4	9	8	21	15	38	22	14	8	6	2	7	2	4		1	164

$r = +0.78 \pm 0.015$

The differences between these coefficients are so small that they may be considered accidental. As the result stands, then it means that exercise tends to accelerate all men equally, regardless of their initial pulse rate or that the individual holds closely to his rank throughout; the slow are always slow, the fast always ahead.

The above calculations serve another function. They are proof that the counts were made with accuracy.

The only comparable attempt to correlate data of this kind, so far noted, is found in a study of pulse and respiration rates by Julia Bell.[1] Her results were:—

Adult males, 20–24	n	r
Pulse rate and stature	253	-0.072 ± 0.042
Respiration rate and stature	253	-0.042 ± 0.042
Pulse rate and respiration rate	255	$+0.108 \pm 0.042$

As these subjects were at rest, we can compare our coefficient for respiration rate and Pulse 1, which is $+0.45$. This is much higher. However, if we correlate normal breathing rate with Pulse 3, the coefficient is but $+0.25$; doubtless had we the breathing rate at the time Pulse 3 was taken, the correlation would have been higher. In any case, the excess of our coefficient over that obtained by Miss Bell, is probably due to the fact that her subjects were examined before rising in the morning.

Blood Pressure. The pulse readings are the only observations that were repeated on the individual, but in blood pressure we have two readings, systolic and diastolic. When we correlate S and D in the same manner as the preceding, we find for the age group 18–27, $n=177$, $r=+0.15$. This is equivalent to a low correlation and means that rank in S is some indication of where one will stand in D. In other words, this means that there is great variability in these respects, so that one cannot definitely predict as to diastolic pressure when systolic pressure is known, and the reverse.

We have also calculated the following correlations for blood pressure:—

	n	r
Blood Pressure (D) and Pulse 3	155	$+0.06$
Blood Pressure (S) and Respiration Rate	171	-0.03

This is equivalent to no correlation.

Vital Capacity and Mobility. When one blows into the spirometer, it may be expected that the volume of air discharged will bear some direct relation to the mobility of the chest. So we have calculated the

[1]Bell, *ibid.*, 232–236.

correlation for the spirometer readings and the mobility of chest, as measured:—

Ages	n	r
18–27	149	+0.47

Thus there can be no doubt that a direct relation exists here.

Other correlations for mobility were obtained, as:—

Ages 18–27	n	r
Mobility and Pulse 3	159	+0.12
Mobility and Respiration Rate	170	—0.34
All ages		
Mobility and Respiration Rate	388	—0.46

Thus there appears a slight tendency for pulse rate and mobility to correlate, whatever this may mean. On the other hand, we note a negative coefficient for respiration rate. This means that if the mobility is great, one breathes slowly; if mobility is low, one can breathe faster.

Temperature. As we have shown, there are good reasons for regarding the temperature series as compound, which would disturb the correlations with temperature somewhat. As no important age differences were noted in either temperature or Pulse 1 we have correlated the entire group, as:—

Ages 18–45	n	r
Temperature and Pulse 1	385	+0.20

This indicates a small amount of correlation and is so far in keeping with the medical tradition that a high temperature is sometimes accompanied by a fast pulse. Of course, we are dealing with what are for the most part normal cases.

We have also calculated the correlations for blood pressure, but here the coefficient is much lower, though with a tendency to be positive, as:—

Ages 18–27	n	r
Blood Pressure (S) and Temperature	171	+0.06
Ages 28–45		
Blood Pressure (S) and Temperature	171	+0.05

We also calculated the correlation for temperature and respiration rate:—

Ages 18–27 $n = 171$ $r = +0.06$

Thus, there is no marked correlation for temperature except with pulse rate. That this is not an accidental finding we have ascertained by dividing the series into two age groups:—

Ages 18–27	$r = +0.22$
Ages 28–45	$r = +0.21$

TABLE 19.

TABLE OF CORRELATIONS.

18–27 years	n	r
Pulse 1 and 2	163	+0.73±0.026
Pulse 1 and 3	164	+0.78±0.015
Pulse 2 and 3	163	+0.86±0.013
Pulse 3 and Mobility	159	+0.12±0.051
Pulse 3 and Blood Pressure (D)	155	+0.06±0.055
Pulse 1 and Respiration Rate	171	+0.45±0.040
Pulse 3 and Respiration Rate	155	+0.25±0.050
Pulse 1 and Temperature	170	+0.22±0.048
Mobility and Vital Capacity	149	+0.47±0.041
Mobility and Respiration Rate	170	—0.34±0.045
Respiration Rate and Temperature	171	+0.05±0.051
Respiration Rate and Blood Pressure (S)	171	—0.03±0.051
Blood Pressure (S) and Pressure (D)	177	+0.15±0.049
Blood Pressure (S) and Temperature	171	+0.06±0.051
18–45 years		
Pulse 1 and Temperature	385	+0.20±0.029
Mobility and Respiration Rate	388	—0.46±0.014

Miscellaneous Medical Data. Medical investigators are now taking a deep interest in the possibility of discovering correlations between functional conditions and anatomical characters. The possibility of such discoveries was recognized in these examinations and data were gathered to test out some of the assumed correlations. For various reasons it has been assumed that correlations may be expected between the following:—

1. Hair form, hair texture, and stature
2. Hair form and skin moisture
3. Hair texture and freckles
4. Development of hair, blood pressure and stature
5. Blood pressure with eyebrow development, form of nose bridge, nose profile, etc.
6. Respiration rate with nose bridge, nose profile, skin texture, etc.
7. Eye color with skin texture
8. Loss of teeth with development of hair, skin color, hair texture, hair form, blood pressure.

At least, these are some of the hypothetical correlations that could be made with the data collected, not to mention the possibility of checking over those well established, such as size and hernia, foot arch and hernia, etc.

We have tried out a few of the foregoing, as may be seen in the accompanying tables. Nothing could be told about hair form and skin moisture because few subjects were rated as moist. The correlation for hair form and hair texture was also generally negative. It is true that the few cases of frizzly hair noted are also coarse, but otherwise the differences are not definite. Reference to the table of ancestry will show that there was no appreciable amount of acknowledged negroid blood in these groups.

Freckles show no relation to skin texture as recorded (Table 20). We have tried out blood pressure with development of eyebrows, nose bridge, and profile as shown in Tables 23 and 24. It seemed unnecessary to calculate the averages for every column in these tables for reasons that are obvious. The difference in Table 24 is no greater than should be allowed for accidental causes. If, however, the 17 cases for low nose bridge are in any way representative of their group, there is a real difference in that a low nose bridge goes with a low blood pressure. Yet the probabilities are against such an outcome.

In Table 25 the observations are more evenly distributed, but again are not large enough to be taken with confidence.

Table 20.

Correlation of Skin Texture and Freckles.

	Freckles Present		Freckles Absent		Totals	
	n	%	*n*	%	*n*	%
Coarse	6	7	28	7	34	7
Medium	62	74	290	76	352	76
Fine	16	19	64	17	80	17
Totals	84	100	382	100	466	100

TABLE 21.

CORRELATION OF BLOOD PRESSURE WITH OUTER THIRD OF EYEBROWS.

Blood Pressure	Outer Third of Eyebrows		Totals
	Present	Absent	
95	1		1
100	2		2
105	2	2	4
110	22	6	28
115	11		11
120	77	9	86
125	20		29
130	104	8	112
135	20	2	22
140	51	3	54
145	10	1	11
150	13	5	18
155	4		4
160	11	2	13
165	1		1
170	5		5
175	2		2
180	4		4
185	1		1
190	1		1
n	362	47	409

CORRELATION OF BLOOD PRESSURE WITH DEVELOPMENT OF NOSE BRIDGE.

Blood Pressure	Nose Bridge			Totals
	High	Low	Medium	
95			1	1
100	2			2
105	3	1		4
110	10	5	14	29
115	6	2	4	12
120	33	5	46	84
125	13		14	27
130	43		51	94
135	12		10	22
140	32	2	24	58
145	4		7	11
150	10		8	18
155	1		3	4
160	6	1	6	13
165			1	1
170	3		2	5
175	1		1	2
180	1	1	1	3
185	1			1
190	1			1
n	182	17	193	392
A	133.34		135.59	
σ	15.45		13.70	
V	.116		0.101	
Em	1.14		0.986	

TABLE 23.

CORRELATION OF BLOOD PRESSURE WITH NOSE PROFILE.

Blood Pressure	Nose Profile			Totals
	Straight	Convex	Concave	
95	1			1
100			2	2
105	2	1	1	4
110	14	11	10	35
115	6	4	5	15
120	37	29	20	86
125	10	8	13	31
130	41	25	26	92
135	11	7	5	23
140	29	14	14	57
145	3	3	4	10
150	9	4	5	18
155	3	2		5
160	7	4	2	13
165			1	1
170	2	2		4
175	1	1		2
180	3		1	4
185		1		1
190		1		1
n	179	117	109	405
A	131.42	131.64	128.45	
σ	15.15	15.75	13.425	
V	0.115	0.119	0.105	
Em	1.13	1.46	1.29	

Nevertheless these negative results need not be taken as final, for the work was not carried on long enough to develop all the necessary special techniques involved. It is true here, as elsewhere, that a certain amount of actual experience with a phenomenon is necessary to the standardization of procedure. Future investigations in this line, must therefore be preceded by the working out of special techniques for recording the qualitative determinations for which correlations are sought.

Summary. A résumé of the calculated coefficients of correlation shows all of them positive in sign, save two. This means that there is some correlation between the processes involved. The number of cases we have is not large enough to establish correlation norms, but these results do make clear the need of such norms. No doubt many institutions in the country possess data that would lend themselves to such treatment, if such research were encouraged.

Some of the suggestions that our data offer are:—

1. Increased mobility of the chest to lower the respiration rate.
2. A rapid normal pulse tends to be coupled with a rapid breathing rate.
3. Normal blood pressure does not correlate appreciably with our other data.
4. Temperature tends to correlate with pulse rate but not appreciably with other data.

308 C

ANTHROPOLOGICAL PAPERS

OF

THE AMERICAN MUSEUM OF NATURAL HISTORY

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THE PUNIN CALVARIUM.

BY

LOUIS R. SULLIVAN AND MILO HELLMAN.

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NEW YORK

1925

THE PUNIN CALVARIUM.

By Louis R. Sullivan and Milo Hellman.

CONTENTS

ILLUSTRATIONS.

TEXT FIGURES.

Introduction

In November 1923 the writer discovered a human calvarium in Quebrada Chalan, Punin, near Riobamba, Ecuador. He was at that time leading a field party of the American Museum of Natural History engaged in a reconnaissance of the Punin ash-beds. This field-work was part of a regular plan for the study of the mammals of Ecuador by the author, and the investigation of the fossil-bearing horizon was made possible through the generosity of Mr. Childs Frick, who financed the work at Punin.

Punin is a small village near Riobamba, in Central Ecuador. It lies on the great interandean plateau and the vicinity has a mean elevation of somewhat more than 9000 feet. This region is within the sphere of influence of several extinct or quiescent volcanoes, as well as some that may be fairly classed as active. The great surface mantle of volcanic ash that overlies this area and which was apparently deposited, for the most part, in Pleistocene time, could have originated from any one or from several of these sources which include Chimborazo, Tunguragua, Altar, Sangay and the more remote Cotopaxi.

The Punin fossil field is by no means a recent discovery. Work has been done there at different times, but apparently no systematic attempt has been made to secure a comprehensive collection of the fossil fauna. An important paper on the Punin beds was published by Reiss and Branco[1] in 1883, based upon rather scanty material gathered by Reiss and Stübel, and Alfred Simson, in his *Travels in the Wilds of Ecuador*, 1886, (page 20), describes the abundance of fossil remains in the ravine near Punin.

The topography of the region is best described as a great basal plain above which rise low hills, greatly eroded, with steep ravines or *quebradas*, and with evidence of severe rain action in the sheer gashes which are cut into the slopes of ash. With regard to the Quebrada Chalan, where most of the fossils were found, it seems likely that the main topographic features were the same in Pleistocene time as they are today. That is to say, the Quebrada existed as such and the ash was deposited in a layer which can be seen to have followed the contours of the ravine. Differences in color show that the ash was laid down at different times and one thin stratum, very dark in color, furnishes a good clue as to deposition and sequence of the strata because it is unmistakable in appearance, regardless of the conditions of erosion. Furthermore, our

[1]Uber eine Fossile Saugethier-Fauna von Punin bei Riobamba in Ecuador. Pal. Abh. 1, heft 2, 1883.

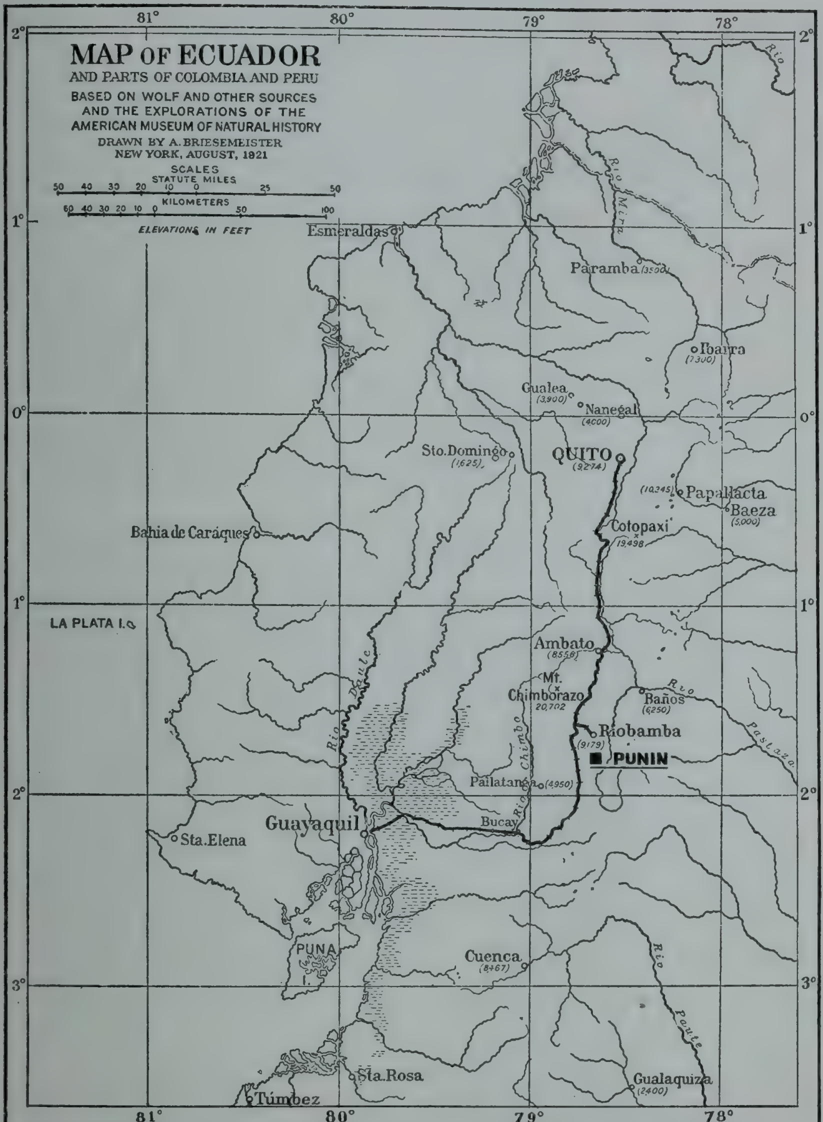
rather superficial reconnaissance led me to believe that this black stratum always lay above the ash where fossils were found.

The bones were encountered in greatest abundance in the quebradas, notably the Quebrada Chalan and the Quebrada Taguan nearby. We had not the time to investigate other cañons, although informed by the natives that they had found bones there. The evidence would lead one to believe that all of the well-formed ravines of the region may hold remains of a fossil fauna. The open hillsides and the flat plains areas yielded nothing to induce extended search, and seemingly the bones were collected in the ravines either because volcanic activity drove the animals to seek shelter there, where gases and ashes overwhelmed them, or else forage conditions were such as to draw them into crowded concentration. I incline to the belief that the deposition of ash was a rapid one and that the fauna of the region was caught and preserved by a volcanic cataclysm.

Bones are found exposed all along the steep slopes of the quebradas where erosion has cut through the compacted ash. At first glance it looks as if the bones were badly scattered and that the streams had tumbled them about in great confusion. The limited amount of excavation which we made showed this impression to be unwarranted, for bones in situ were quite apt to be elements of a skeleton concealed within the bank. Wherever stream action had washed a skeleton out of the ash single bones were found lying on the surface and no association might be attempted for such a specimen. The stratum of ash which carries fossils is not very deep, but a few feet in most places, and although the aspect of this bed changes somewhat with the locality, being darker where water can seep into it, or denser or looser in texture as the case may be, still it can be easily recognized, as a rule, for what it is.

The human cranium was discovered by Mr. G. H. H. Tate, the field assistant, on November 2, 1923. The skull was in a low bank, directly over the water-course of the Quebrada Chalan, down which a trickle of water flows normally but which is subjected to torrential violence when rains are heavy. As soon as enough of the bank had been removed to see that the specimen was human, excavation was suspended and photographs were taken.

The bank at this point is about six or seven feet high and the ash rests upon a floor of syenite which is swept clear by the water. Consequently any bones that might be weathered out of the bank would be carried on down the quebrada by the first heavy rain. Most of the ash strata are compacted into a tuff, a tough, semi-elastic formation, but


MAP OF ECUADOR
AND PARTS OF COLOMBIA AND PERU
BASED ON WOLF AND OTHER SOURCES
AND THE EXPLORATIONS OF THE
AMERICAN MUSEUM OF NATURAL HISTORY
DRAWN BY A. BRIESEMEISTER
NEW YORK, AUGUST, 1921
SCALES
STATUTE MILES
KILOMETERS
ELEVATIONS IN FEET
81°
80°
79°
78°
2°
1°
0°
3°
Esmeraldas
Paramba
Ibarra (7300)
Gualea (3,900)
Nanegal (4000)
Sto. Domingo (1,625)
QUITO (9274)
Papallacta
Baeza (5,000)
Cotopaxi 19,498
Bahia de Caráques
LA PLATA I.
Ambato (8556)
Mt. Chimborazo 20,702
Baños (6250)
Riobamba (9179)
PUNIN
Pallatanga (4,950)
Bucay
Guayaquil
Sta. Elena
PUNA I.
Cuenca (8467)
Sta. Rosa
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Gualaquiza (2400)
Rio Mira
Rio Daule
Rio Chimbo
Rio Pastaza
Rio Paute

Fig. 1

where the calvarium was found a slow seepage has prevented this packing down of the ash and the formation is looser as well as quite damp to the touch. The skull was so damp when it was removed that it was exceedingly friable and broke under its own weight. After it had dried out in the air the texture of the bone became fairly dense and quite comparable with the bones of horses, camels, mastodons, etc., found in the quebrada.

While the remains of the Pleistocene mammalia are scattered up and down the Quebrada Chalan for many hundreds of yards, there are intervals where no bones may be found, although these gaps are not very extensive. The human cranium was found in one of these intervals and for this reason its association with horse, camel, and mastodon cannot be asserted as an incontestible inference. It is true, however, that the bones of these mammals can be found within from fifty to one hundred feet from this spot and throughout nearly three quadrants of the compass; and I should judge the bank to be of the same geological origin as these nearby bone-carrying beds, although somewhat disguised in appearance because of the seepage.

No human bones other than the cranium were found although a search, forced by the time available to be somewhat brief, was made deeper into the bank. Any parts of the skeleton which may have washed from the bank could not have remained on account of the stream below. The position of the skull, inverted with the tooth-row upward, was not that of a normal burial, and the absence of other bones strengthens this impression. Weighing all of the evidence carefully, I think serious consideration must be given to the implied contemporaneity of this cranium with the Pleistocene species of the Punin beds.

There can be no doubt as to the Pleistocene nature of the Punin fauna. The commonest species of the region is a true horse, probably *Equus andium.*[1] Teeth of the Andean horse are quite common and skulls with more or less complete skeletons are by no means rare. Probably the most spectacular element in the fauna is the Andean mastodon, *Dibelodon andium.* A tooth of this huge creature was secured and occasionally portions of the large skeletal elements of the mastodon were seen exposed along the quebrada. A good-sized species of ground sloth, *Mylodon sp.?* occurred in this region in Pleistocene time and we found its bones and collected them in numerous spots. Less abundant than the Andean horse, but a characteristic animal of this period is the so-called camel, *Protauchenia,* which is found sparingly in the Quebrada Chalan. Other forms, collected either by the American Museum party or by Reiss and

[1]As soon as the Punin material has been cleaned for examination a report on the fauna will be published and more definite identifications given.

Stübel, include *Arctotherium* sp.?, *Smilodon*, sp.?, a cervid, a canid, and representatives of present day genera such as *Sylvilagus*, *Oryzomys*, etc. As it exists today, the Punin region is poor faunally, compared to the Punin of Pleistocene times.

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When turned over to the Department of Anthropology for craniological and craniometric analysis, the calvarium was broken into many pieces. The fragments, however, were rather large, for the most part, and the calvarium was reconstructed very satisfactorily by Mr. S. Ichikawa, under the supervision of Doctor Milo Hellman. While several portions are still lacking, the calvarium, as restored, is a very satisfactory craniological and a fairly satisfactory craniometric specimen (Fig. 7). It has been catalogued as number 99–8271.

The sex of the calvarium is not clear. We have somewhat hesitatingly designated it as that of a female of mature years. In several features it approaches masculinity, but a majority of its features indicate the opposite sex.

In norma verticalis it is ovoid in form (Fig. 7c). The parietal eminences are moderately prominent. The coronal suture is of medium complexity and beginning to disappear. The sagittal suture is also moderately complex and its ramifications average more than a centimeter in width. About 3 centimeters posterior to the bregma the region of the suture becomes a shallow groove which widens into a conspicuous fossa in the region anterior to the obelion. The occipital portion is very prominent. There are extensive grooves on the right and left sides of the frontal bone.

In lateral view the general lowness of the cranial vault and face are the most noticeable features (Fig. 9). The face is somewhat projecting. The sagittal contour rises in a low arc from the metopion to the vertex which is about midway between the bregma and the obelion.

In facial view one is struck by the very low face and low orbits (Fig. 7b). The glabella is moderately well developed and the supraorbital ridges extend slightly beyond the mid point of the superior orbital border. The glabellar and supraorbital development is not marked for a male, but is marked, if the specimen is female. The vault is somewhat scaphoid in frontal view, although the acute arching of the vault is not striking until the vertex is reached. As noted above, the orbits are very low and widely rectangular in shape. The lower border of the nasal aperture is infantile in form. The crista lateralis (Gower) does not fuse with the crista spinalis but divides about 5 millimeters below the floor of the aperture and sends a branch to each of the upper incisors. In this view too will be noted the upper left permanent canine which appears in the

frontal process of the maxilla. The tooth is reversed with the apex of the root near the root of the upper left first premolar and the cusp point on a level with the lower border of the orbit. The lingual surface is turned facially.

A portion of the basal region is lacking, especially the greater part of the basi-occipital and the sphenoid. As remarked in the vertical view the occiput is well developed. There is a well marked occipital torus. The mastoid processes are very small. The tympanic plates are both perforated.

The dental arch is rather diminutive in size and in form. This is not due to the size and form of the teeth constituting it, but rather to the anomalous condition associated with the congenital absence of the third molars and to the malposition of the left canine. Thus, while the lack of the molars shortens the dental arch antero-posteriorly, the absence of the misplaced canine reduces it in width. (Fig. 8.)

The teeth present are of unusually large size. They are considerably longer, though about the same width, as the average Australian teeth, which assume unusually large dimensions. The character of wear of the teeth corresponds closely with that seen in Australian dentitions. In certain Australian skulls the premolars and molars present either planes, convexities, or very slight concavities on the occlusal surfaces when the teeth are considerably worn. These surfaces nevertheless remain at or close to right angles of the long axes of the teeth. In American Indian teeth, on the other hand, the occlusal surfaces after wearing down, are at an acute angle on the buccal and at an obtuse angle on the lingual side to the long axis of the teeth.

Although the calvarium has been partially restored, it lends itself to fairly accurate measurement. The basion is lacking and all measurements from this point are estimates, based on measures taken with the basion restored in clay. Width of face and width of nose were obtained by measuring the distance of the left zygion and the most exterior point of the left border of the nasal aperture from the median sagittal plane and then multiplying these values by two. The angles have been read directly with Mollison's craniophor and Ansteckgoniometer. The measurements were taken independently by Sullivan and Hellman and then checked over together. Where discrepancies and differences appeared the diameter was re-measured by them together and the most probable measure obtained. The measures obtained were:

Cranial capacity, estimated by formula	1275????cc.
Maximum length	186mm.
Maximum breadth	132
Basion-bregmatic height (basion restored)	124????
Ear-bregma height	109
Ear-vertex height	115
Minimum frontal diameter	89
Basion-nasion (basion restored)	93????
Basion-prosthion (basion restored)	97????
Maximum bizygomatic width (X2)	125??
Upper face height	60
Nasal height	42
Nasal width (X2)	25??
Orbital width from maxillo-frontale	41
Orbital width from dacryon	40
Orbital width from lacrimale	39
Orbital height	29
Maxillo-alveolar length	53
Maxillo-alveolar width	58
Angles	
Profile angle—Nasion-prosthion—eye-ear plane	80° to 81°
Alveolar angle—eye-ear plane	66°
Bregma-nasion—eye-ear plane angle	52°
Bregma-glabella—eye-ear plane angle	47°
Indices	
Length-breadth	71.0
Length-height	66.7????
Breadth-height	94.0????
Length-ear height (bregma)	58.6
Length-ear height (vertex)	61.8
Modulus	147.0??
Transverse fronto-parietal	67.5
Alveolar projection	104.3????
Cranio-facial transverse	94.5
Upper facial	48.0?
Nasal	59.6?
Orbital (maxillo-frontale)	69.2
Orbital (dacryon)	72.5
Orbital (lacrimale)	74.4
Maxillo-alveolar	109.3

Our problem, as we see it, is to allocate this calvarium racially. The ideal way to approach such a problem would be to have been given a skull with all data of location withheld. This would eliminate the possibility of prejudice which is sure to exist once the locality of the find is known. In our own case these ideal conditions were not met. The calvarium was turned over to us with the definite information that it was

an American skull from Ecuador. This information, of course, immediately prejudiced us against the possibility of its being other than ordinary American Indian remains. But in spite of this prejudice we could not escape the conclusion that the calvarium was definitely Australoid in appearance. This is suggested very strongly by the cranial vault and the facial region. The glabellar region, the orbits, and even the nasal region suggest this. The form and wear of the teeth also recall Australian teeth.

We realized that superficial resemblances are often misleading and that detailed analysis sometimes reveals marked differences which have been overlooked. But in this instance at least the metric analysis bears out our first impressions. Practically every index points to the Australoid norm. If we select a dozen of the most definitive indices and measures (cranial capacity, length-breadth, length-height, breadth-height, fronto-parietal, gnathic [alveolar-projection], transverse cranio-facial, upper facial, nasal, orbital, maxillo-alveolar indices and facial angle) and plot their distribution in different cranial series in the form of curves, we find that the calvarium in question best fits the norms of cranial series from Tasmania, Australia, and New Guinea. In America crania of this type are rare, but it most closely approaches the norms of the Pericue (Lower California), Lagoa-Santa (Brazil), and Paltacalo (Ecuador) material. It approaches much less closely the Santa Catalina, California mainland, Virginia, and New York State Indian series. It is most reasonable, of course, to say that it probably belongs to what has been quite widely described as the Lagoa-Santa type (Lagoa-Santa, Pericue, and Paltacalo material). However, it differs very markedly from the average of this type in the low cranial vault and the low orbits. The low face and nose also approach the extreme limits of this type. In these very characters, of course, it approximates most closely the Tasmanian and Australoid norms.

We believe that if the calvarium in question were presented to physical anthropologists, with no data or hints as to its origin, a majority of them would say that it was Australoid or at least that the chances of duplicating it were infinitely greater in Australia and Melanesia than in any other part of the world. This was our reaction to it, and a physical anthropologist of experience upon whom we were able to try the experiment outlined above, said, without hesitation, that the skull was Australian. We have also been able to duplicate it more closely in our collection of Australian and Melanesian crania than among our American crania. While it undoubtedly is American in the sense that the Lagoa-Santa,

Pericue, and Paltacalo material is American, it is not a common American calvarium. After all, the Lagoa-Santa type is not common in America. It has been found very sporadically.

If we accept the statement that the Punin calvarium under discussion is very probably of the Lagoa-Santa type, we have simply pushed the problem back one step further, for there are very decided differences of opinion as to the racial affiliations of the Lagoa-Santa type.

The whole problem hinges on the conception of the racial affiliations of the American aborigines as a group. Hrdlicka, who has had greater opportunities and more experience than any one else with American somatic and osteological material, has repeatedly asserted that the American Indians, both living and dead, are fundamentally of one racial type. A typical statement of this author is that found in his *Early Man in South America*:[1]

> . . . The fact is that the American stem or homotype is not homogeneous; it presents in different tribes and localities the extremes of head form and also numerous other pronounced differences. Yet, the living Indian, as well as his skeletal remains, are characterized throughout America, from Canada to the limits of Tierra del Fuego, by certain fundamental traits that indicate unity in a more general sense of the word. This is not the place, however, to go into detailed enumeration and discussion of these traits. (Reference is here made to an earlier but not much more detailed discussion of this question). It may suffice to say that they apply especially to the facial features, the nasal aperture, the malar bones, the maxillæ, the base of the skull, the teeth; but they extend also to certain characteristics of the vault itself and beyond that to the forms and relative dimensions of numerous parts of the skeleton. This general American type is more or less related to that of the yellow-brown peoples, wherever these are found without decided admixture with other strains. These yellow-brown people, including the American, represent one great stream of humanity. In this way it is explainable how the crania from Brazil, and again those of southern California, with still others, have been found to present resemblances to the Polynesians, or even to some of the less negroid Melanesians; it is a basal or *souche* relation, and the Americans may well be wholly free of any connection, except the ancient parental contact with these branches.

This opinion, coming as it does from a leading American physical anthropologist, is widely accepted in America, especially in so far as it applies to the well-known tribes of living American Indians. It must be admitted by all who have studied American Indians in any detail that a majority of them are more or less completely mongoloid in their appearance. However, several non-American anthropologists have questioned this homogeneity of the living Indians. A large number have also questioned the homogeneity of the American stock as represented by skeletal material. Without going into detail and recounting all of these opinions

[1]*Bulletin 52, Bureau of American Ethnology* (Washington, 1912), 183.

it will be to the point to mention the opinions of a few of the leading anthropologists who have had doubts as to the homogeneity of American skeletal material, in general, and who particularly have claimed that the type under discussion (Lagoa-Santa) is not ordinary American Indian material.

Quatrefages,[1] Ten Kate,[2] Rivet,[3] and Soren Hansen[4] have expressed the belief that the Lagoa-Santa type is related to the Papuans and Melanesians. The opinions of such men as these must also carry weight. In so far as craniometric results testify, they bear out the contentions of these non-American authorities.

Only two conclusions are possible. Either we have, in certain parts of America, skeletal remains of a type basically related to those found also in Australia and Melanesia and fundamentally different racially from the prevailing mongoloid American Indian types, or we have a remarkable case of parallelism—parallelism sufficiently detailed to deceive physical anthropologists of very wide experience. At present it is not possible to decide which of these conclusions is closer to the truth. We need much more detailed studies not only of the skull, but of the other parts of the skeleton.

In so far as the calvarium under discussion is concerned, we can only say that there is absolutely no basis for excluding it from a series of Australian or Tasmanian crania and every reason for including it. It is quite possible that if we had the mandible and other parts of the skeleton our decision might be different. We wish to emphasize particularly the point that in claiming that this calvarium is Australoid we have in mind a basic racial relationship and do not believe that it necessarily represents migration from Australia or Melanesia. We feel that unless this is indeed a very remarkable case of parallelism, this type in America and the similar type in Australia and Melanesia are derivations of the same basal racial stock.

How largely this type is represented in the living Indians of today is not at all clear, nor are the tribes usually identified as its representatives entirely satisfactory as such.

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[1]Quoted by Soren Hansen in Footnote 4, below.

[2]Ten Kate, H., "Materiaux pour servir à l'Anthropologie de la presq'île Californienne" (*Bulletin Société d'Anthropologie de Paris*, 3rd series, vol. 7, Paris, 1884); Ten Kate, H., "Sur les Crânes de Lagoa-Santa" (*Bulletin, Société d'Anthropologie de Paris*, 3rd series, vol. 8, 240–244, Paris, 1885).

[3]Rivet, P., "La Race de Lagoa Santa chez les Populations Précolombiennes de l'Equator (*Bulletin et Memoires, Sociétié d'Anthropologie de Paris*, 5th series, vol 9, 209–274; also 314–430 with R. Anthony, Paris, 1908); Rivet P., "Recherches Anthropologiques sur la Basse-Californie" (*Journal de la Société des Americanistes de Paris*, new series, vol. 6, 147–253, Paris, 1909).

[4]Hansen, Soren, "Lagoa Santa Racen" (*Samling af Afhandlinger, Museo Lundii*, vol. 1, part 5, 1–37, Copenhagen, 1888).

We have not touched upon the age of the calvarium in question because we feel that this is not within our province. The day of anatomical determination of age is passing, particularly in America. Age is a matter to be settled by the geologist and archæologist. We can only say that this specimen is quite clearly *Homo sapiens* and no more closely related to *Homo primigenius* than many other modern races.

The interesting points, as we see them, are the racial affiliations of the type and the fact that in several instances this type has been found under the suspicion of being old, archæologically at least.

Fig. 2. General Topography of the Punin Region. The village of Punin lies just beyond the left-hand margin of the picture, in the valley. The mountain in the background is Chimborazo.

Fig. 3. Ash-Beds of the Quebrada Chalan showing Erosion. Fossils occur in this type of formation.

Fig. 4. Water Hole in the Quebrada Chalan. The human cranium was in the low bank which enters the picture at the left.

Fig. 5. The White Object, above the Pick Handle, is the Human Calvarium in situ, before the Bank was disturbed.

Fig. 6. Skull as it appeared before Excavation had gone very far. The white surface is the original exposure.

a b c

Fig. 7. The Calvarium: a, Norma Occipitalis; b, Norma Frontalis; c, Norma Verticalis

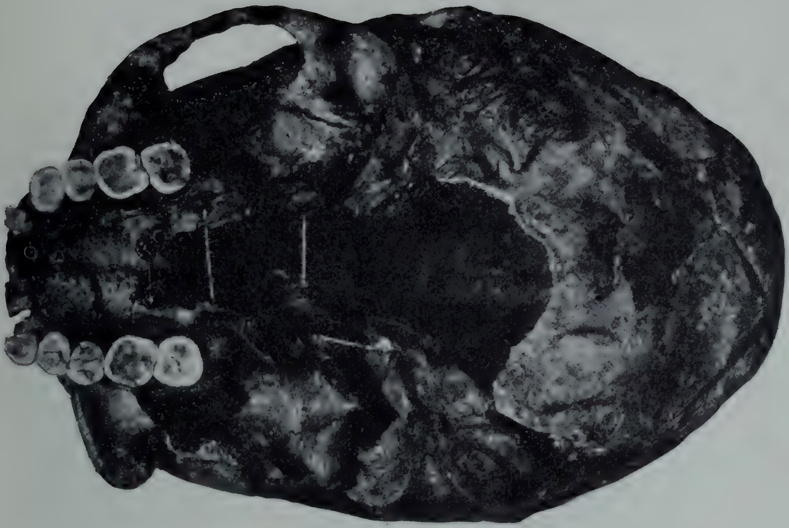

Fig. 8. The Teeth and the Palate.

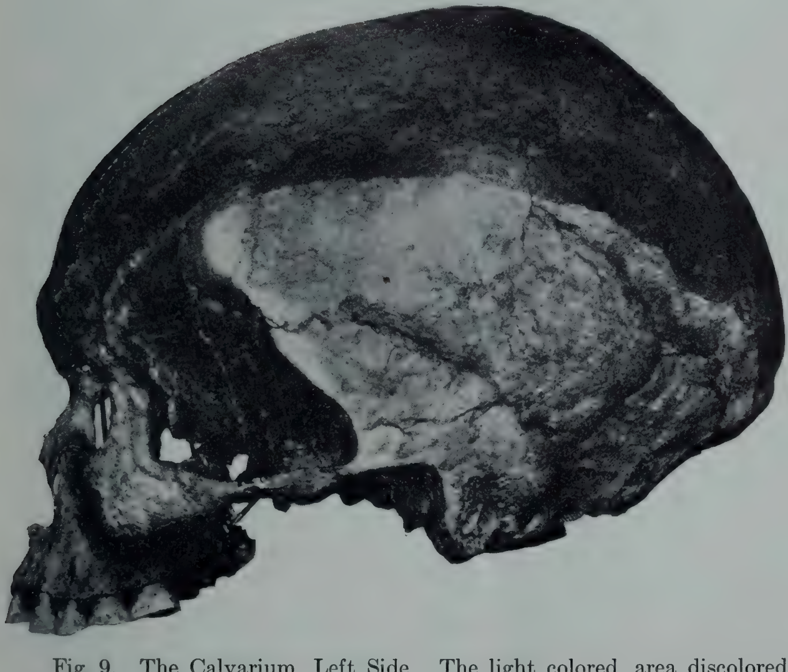

Fig. 9. The Calvarium, Left Side. The light colored area discolored by exposure.

INDEX